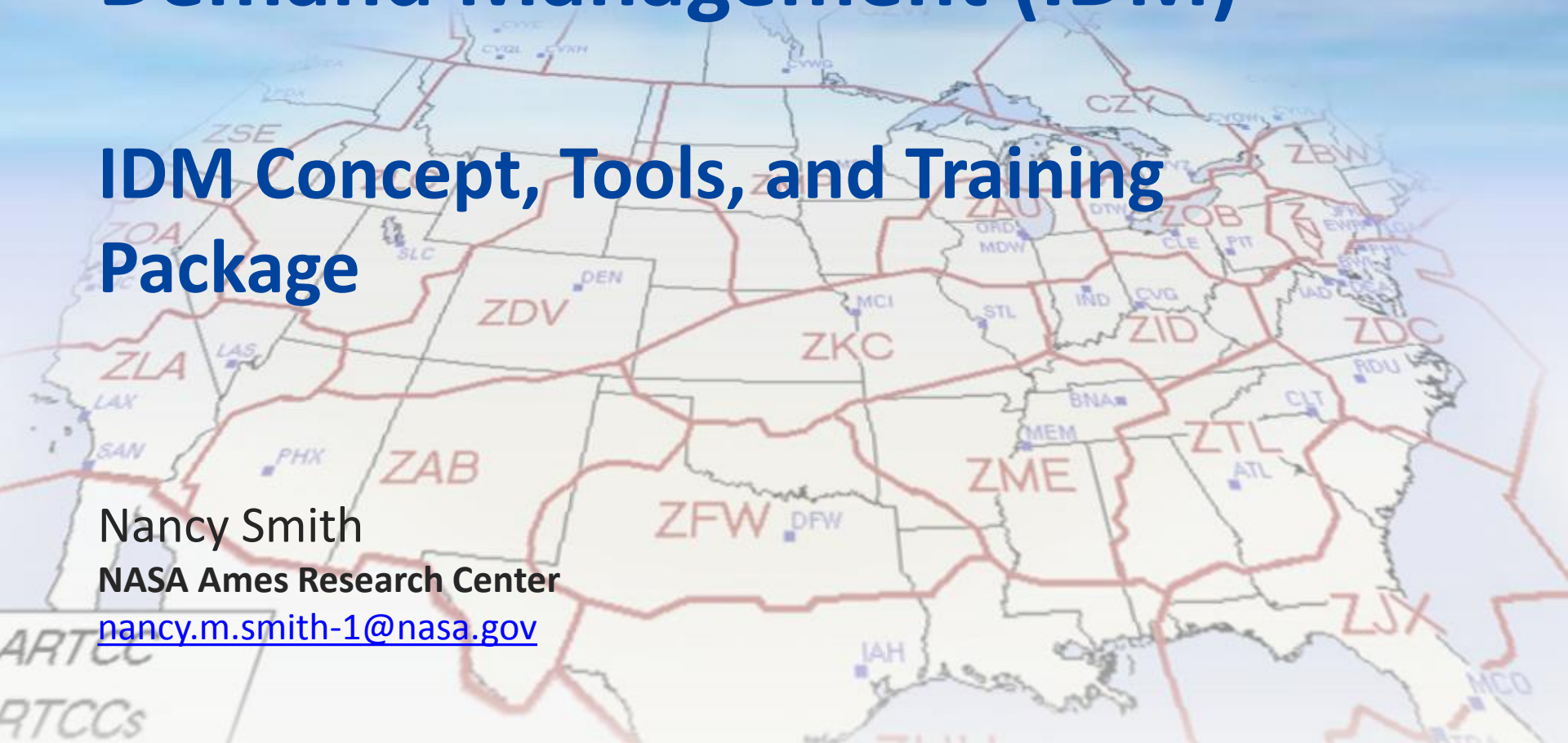


NY TBO Research: Integrated Demand Management (IDM)

IDM Concept, Tools, and Training Package

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NY TBO Research: Integrated Demand Management (IDM)

Out-brief on March IDM Exploratory HITL with FET at NASA Ames

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Contents

- Concept summary
- Objective of exploratory HITL activity
- Integrated Demand Management (IDM) problem, concept, and simulation environment
- Some observations

IDM Concept Summary

IDM integrates 3 key technologies to better match traffic demand to capacity of a constrained resource:

1. CTOP TMI “strategically” manages demand into TBFM
2. TBFM “tactically” manages delivery to capacity-constrained destination
3. RTA provides key delivery mechanism from TFMS into TBFM

Objectives for Exploratory HITL

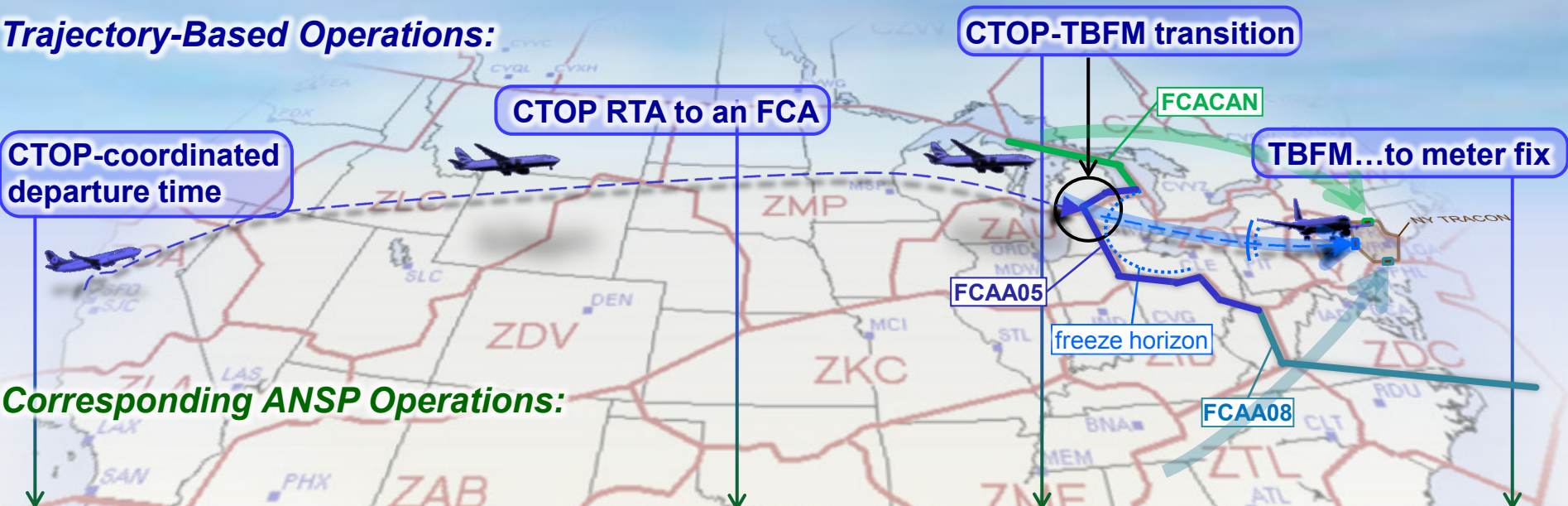
- Obtain Flow Evaluation Team members' guidance in two specific areas:
 1. Design of CTOP TMI for pre-conditioning of TBFM demand
 2. Delegation of “meet-time” conformance task to flight deck
- Get general feedback regarding operational feasibility, perceived benefits, issues or concerns

INTEGRATED DEMAND MANAGEMENT CONCEPT

Integrated Demand Management

Develop an air-ground TBO concept that integrates near-term to mid-term NextGen technologies to manage demand through capacity constrained resources to a capacity constrained airport, with an initial focus on New York operations.

Trajectory-Based Operations:



Corresponding ANSP Operations:

Implement CTOP

- Select appropriate FCA(s).
 - Model and determine FCA rates.
 - Initiate program: assign routes, EDCTs, and/or RTAs to manage FCA arrival times.
- Implement revisions (to CTOP; RTAs or EDCTs) as needed.

Manage “pre-TBFM” ops

- Support RTA operations.
- Manage departures.
- Conduct ATC operations for RTA and non-RTA flights.
- Monitor & maintain plan.

Transition to TBFM

- Conclude RTA with transition to TBFM.
- ATC begins managing aircraft to meet TBFM scheduled STAs.

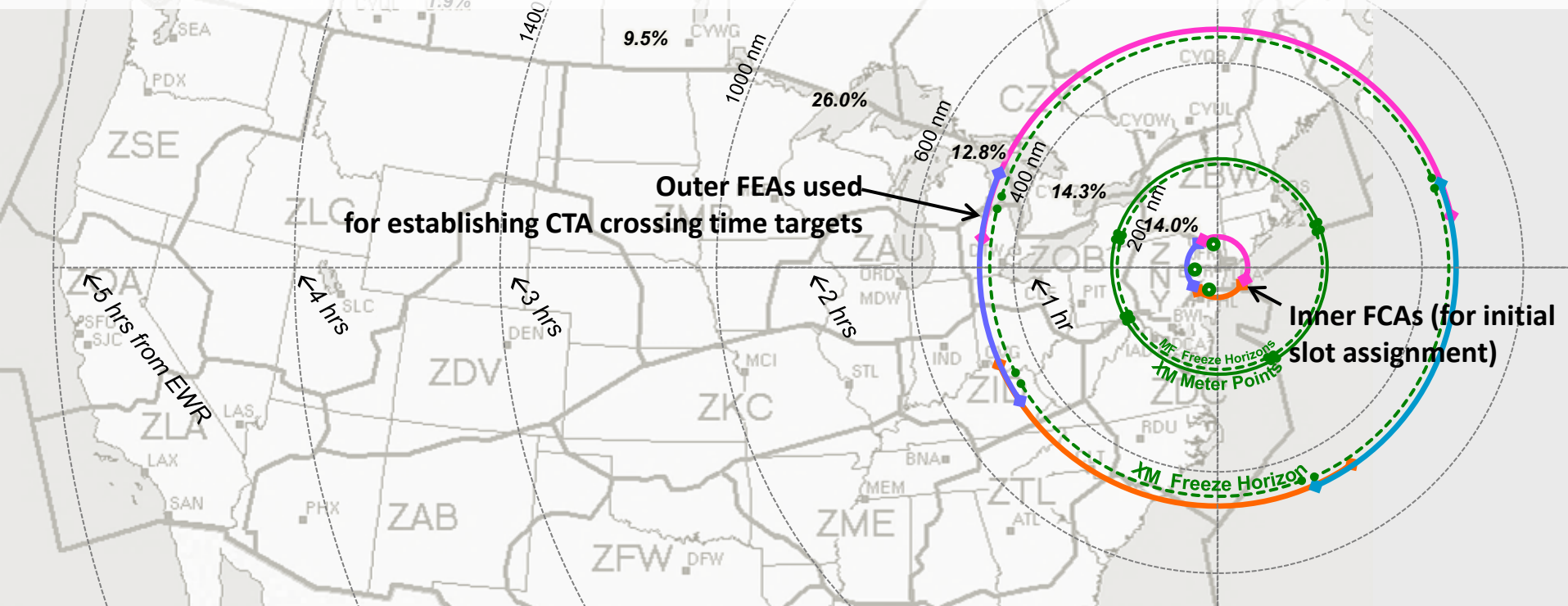
TBFM to destination

- TBFM “2-stage” scheduler manages traffic to runway threshold.
- Close-in departures are scheduled from TBFM near CTOP-assigned EDCT times.

Proposed Scheduling Approach

3 scheduling classes, based on departure location relative to CTOP-TBFM transition boundary.

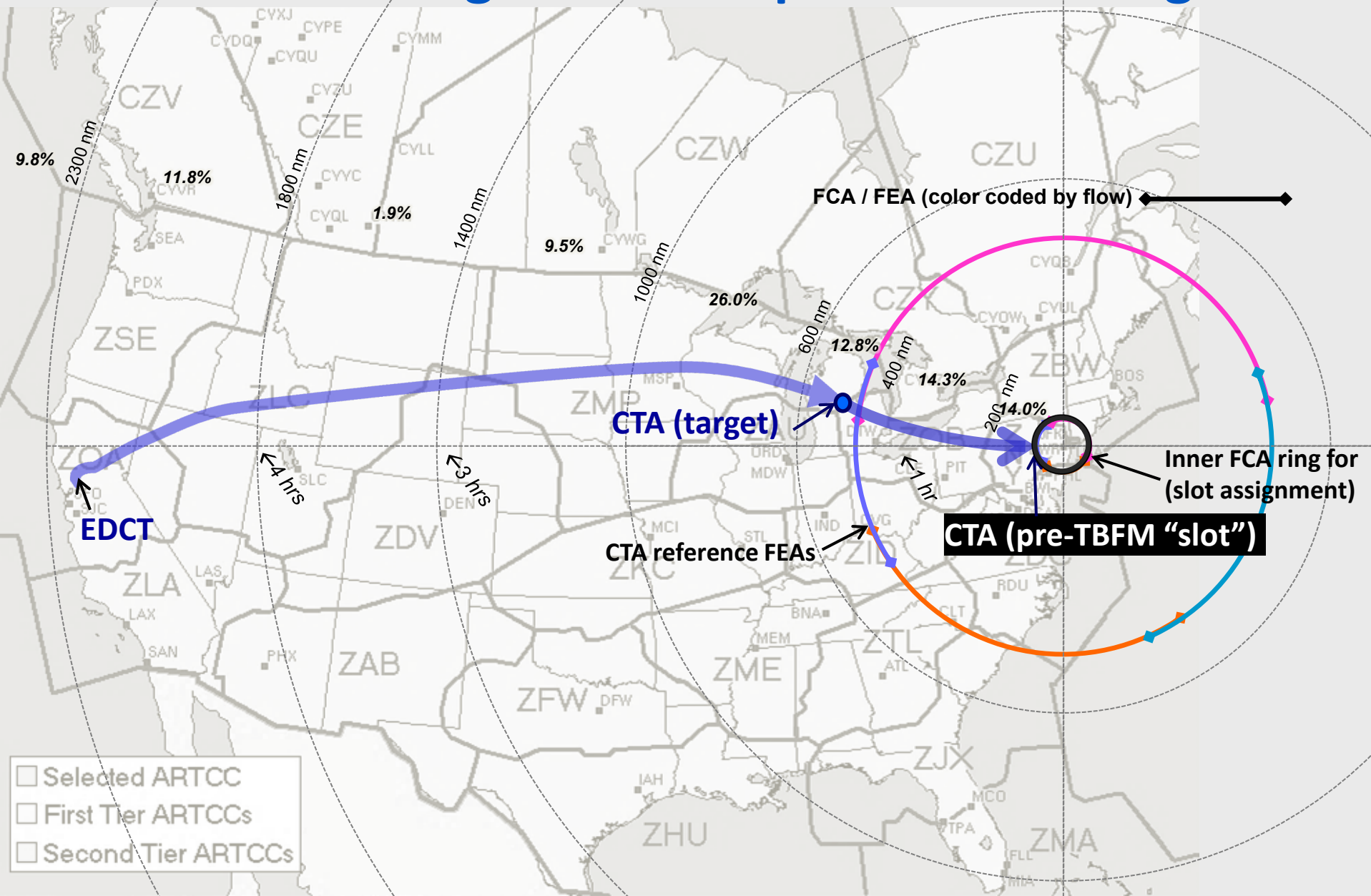
- **Class 1** (most distant) have slot time for inner FCA with EDCT and RTA to outer FCA after top of climb.
- **Class 2** have slot time for inner FCA with EDCT, but depart too close to boundary for RTA assignment.
- **Class 3** have slot time for inner FCA with EDCT, but final departure time is scheduled from TBFM.



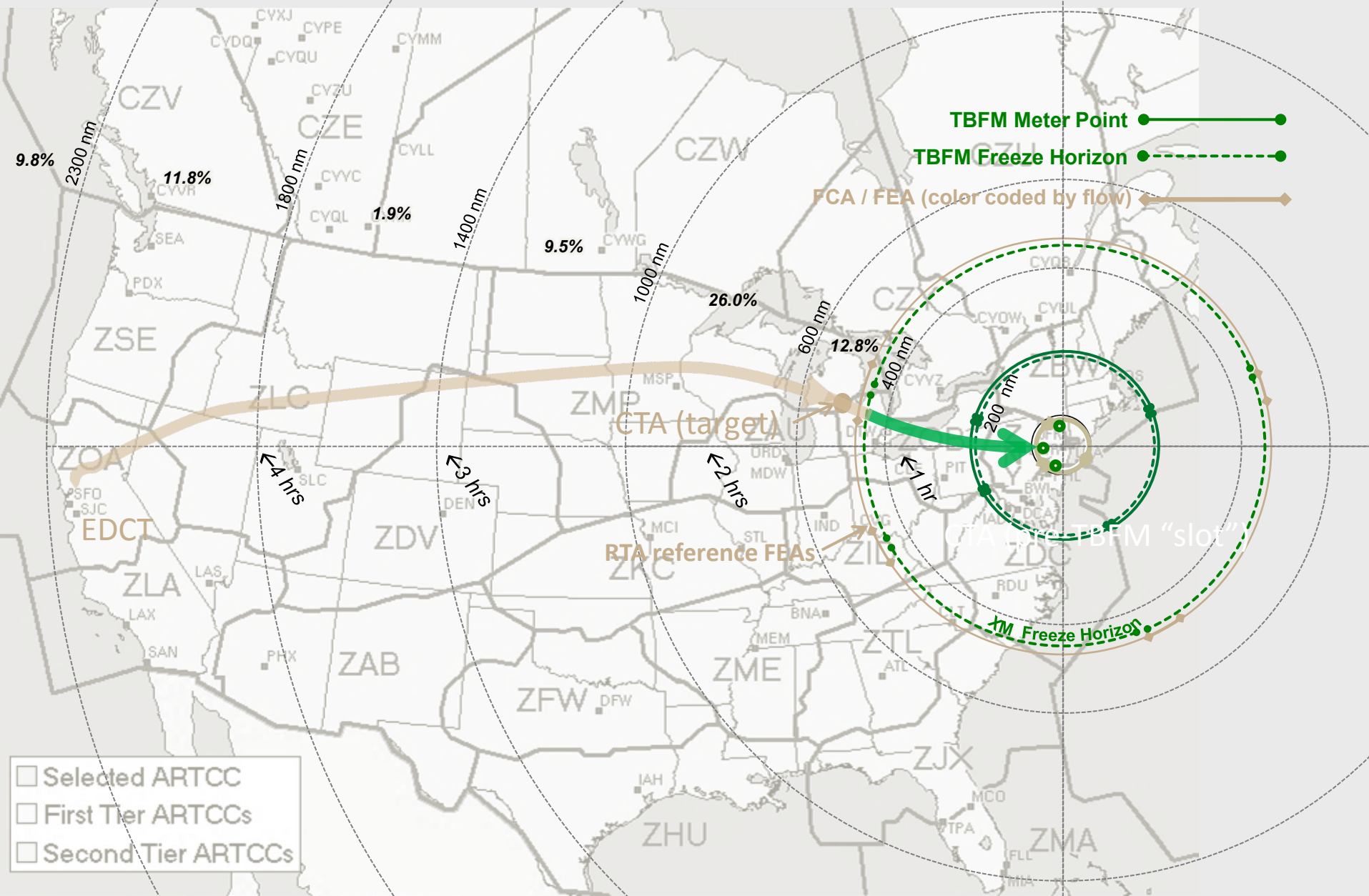
In summary:

- All flights have a slot time for an inner FCA with a corresponding “Scheduled Departure Time” (~EDCT).
- All slots can be swapped before departure.
- Flights from more distant airports also have an associated entry time at an outer FCA arc.

CTOP TMI Targets for sample SFO-EWR flight



TBFM Overrides CTOP TMI after Freeze Horizon



Topic 1: Explore different FCA options

- Explore use of more complex solutions with “slot-scheduler” FCA structures for fix load balancing
- Explore processes for adjusting flow capacity and demand (both decrease and increase)

Some Feedback on Topic 1

- Simplest “ring” solution is equivalent to GDP, with addition of CTA control to TBFM entry.
- More complex solution (e.g., using 2 or 3 inner arcs) are necessary for fix load balancing
- More complex solution could benefit from automation support (e.g., advisories) for assigning capacity distribution across flows
- Important to have a good estimate of target capacity when setting FCA values

Topic 2: Explore IDM “r”ta Ideas and Issues

- Consider ***why, how, and where*** RTA might be used
- Explore ***issues*** associated with its use...
- Assuming the target FCA crossing time comes from CTOP, how is it communicated to the flight deck (and others)?
- Two alternatives:
 1. From AOC to flight crew to controller:
 - rTA time accompanies EDCT (pre-departure)
 - Flight strip or data block annotated to indicate rTA status (similar to NRP)
 - What about updates to airborne flights?
 2. From CTOP to controller to flight crew:
 - At this point, Command Center, TMU role unclear; controller’s responsibilities unclear. Probably would require a more fleshed out simulation environment to get a handle on this.

Some Feedback on Topic 2

- The target time of arrival may not need to be an RTA clearance, but could instead be associated with a TMI.
- Propose using “CTA” as term for flight crew objective.
- To streamline delivery, propose assigning the CTA along with the EDCT.
- Controller may need to know that flight is controlling to target time. Two methods proposed for controller awareness: (1) flight crew informs controller on check-in, or (2) status could be flagged on electronic flight strip (precedent: EDCT).
- Revision or assignment process for *in-flight* aircraft is still an open question.

Topic 2 Feedback (continued)

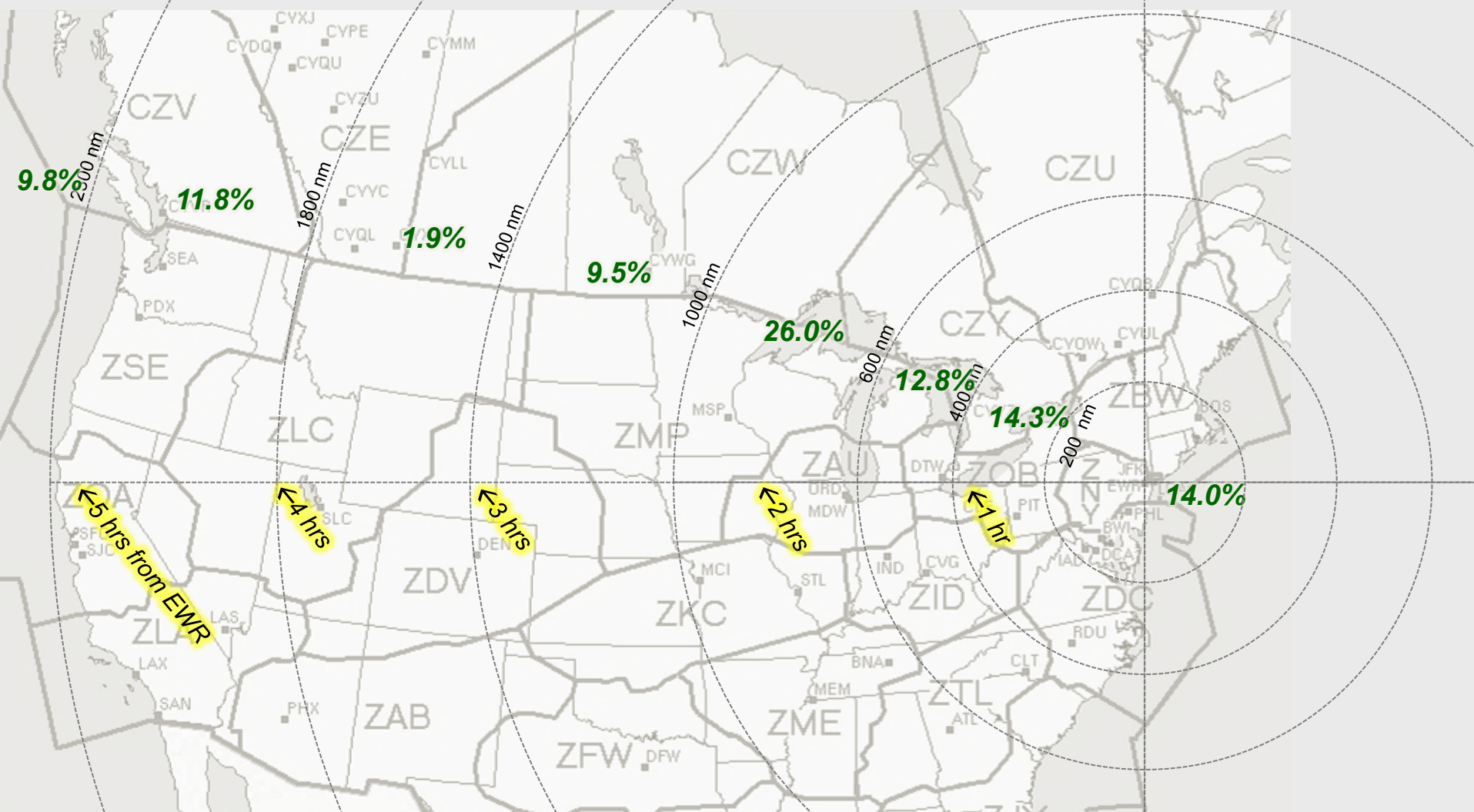
- Need to determine CTA conformance requirements
- If not a clearance, need to make sure there's a clear benefit to the individual flight for its participation

Next Steps

- Continuing feedback assessment from last week's activity
- Targeting end of April for report delivery to FAA
- IDM paper will be presented at ATIO (June 2016)

END

Newark Arrival Traffic

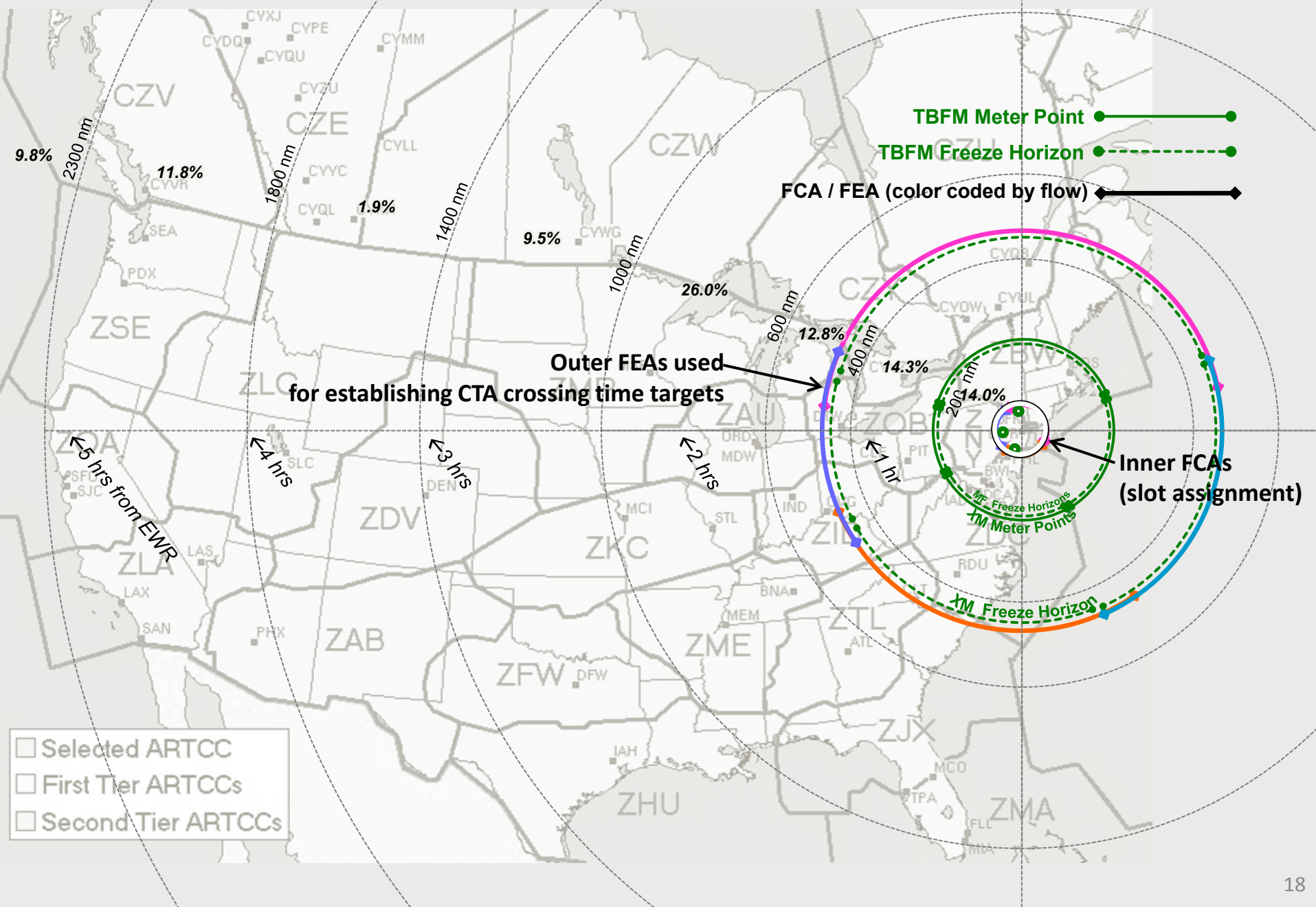


EWR Arrivals: Distribution by Departure Airport Distance, all filed flights, 2013*

- First Tier ARTCCs
- Second Tier ARTCCs

*Does not include airports with less than 40 flights to EWR in 2013 (ASPM).

Notional Location of TBFM and FCA Constraints

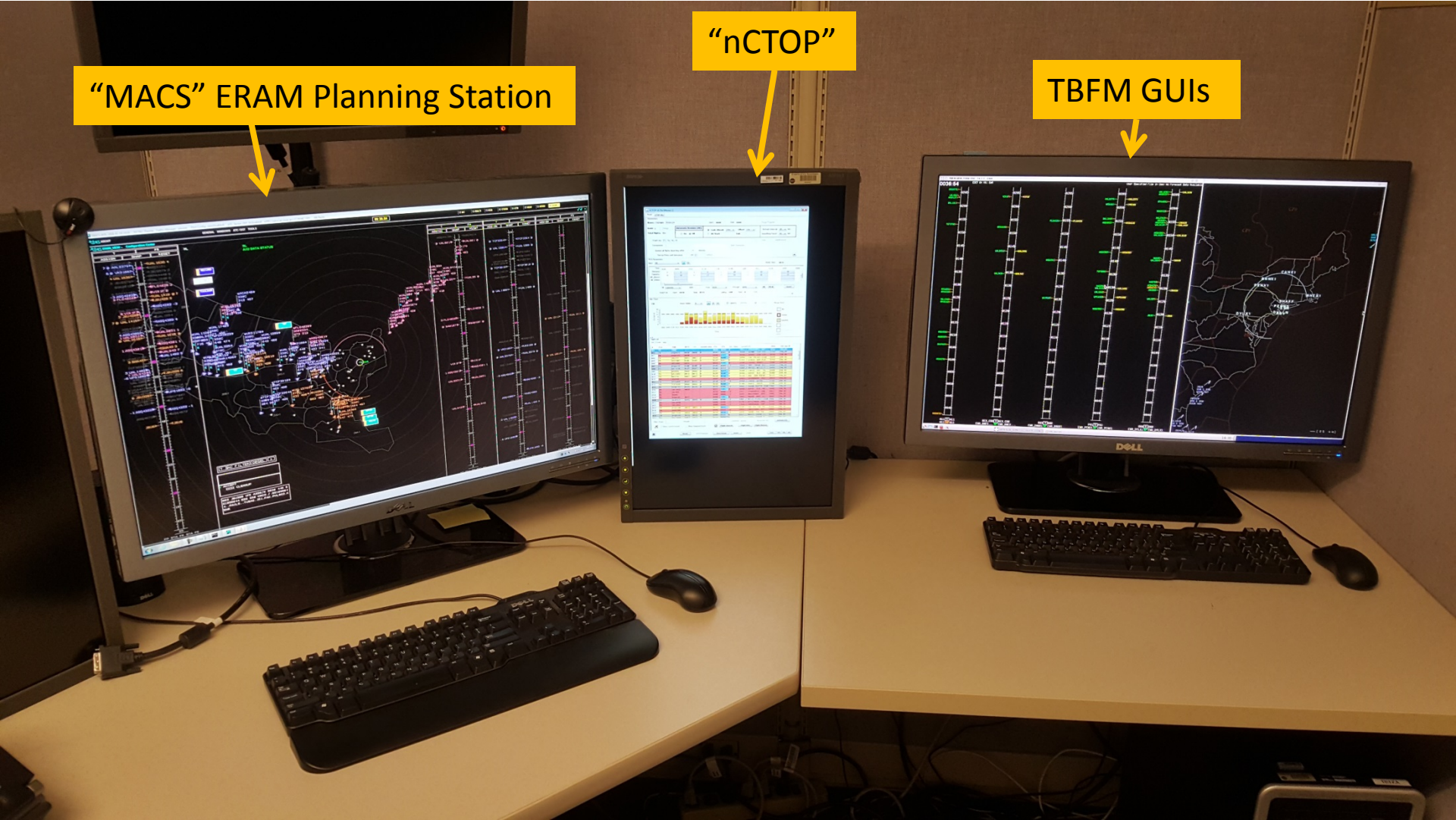


Simulation Station

“MACS” ERAM Planning Station

“nCTOP”

TBFM GUIs

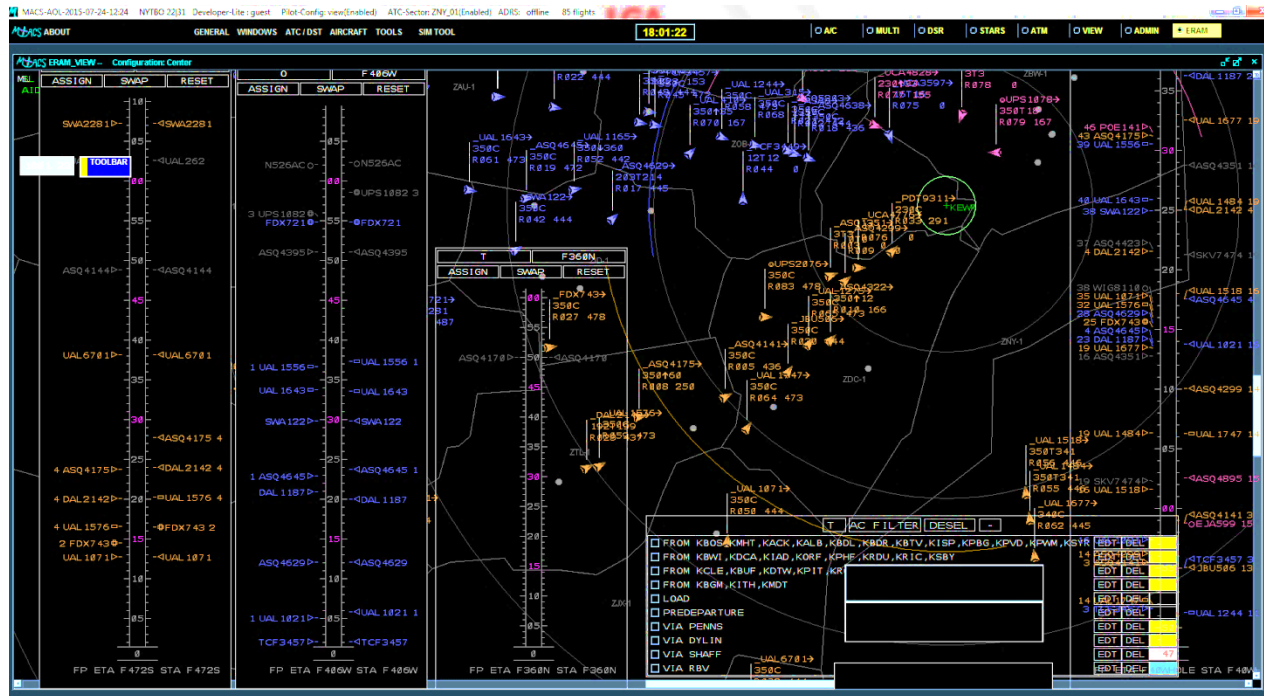


CTOP

CTOP = “MACS” airspace simulation, including prototype scheduler controlled by “nCTOP” emulation

MACS

nCTOP



Demand (ETAs) at different FCAs → Table / Bar Chart displays
Sets spacing for slot assignment scheduler (STAs) ← Bin capacity settings

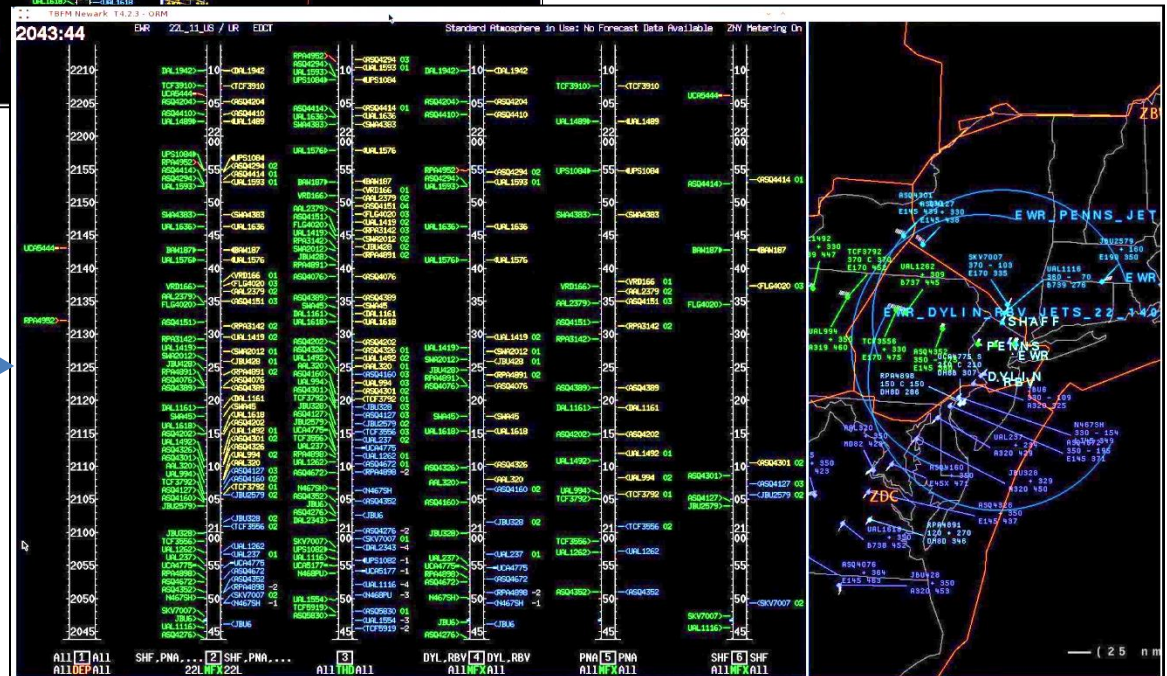


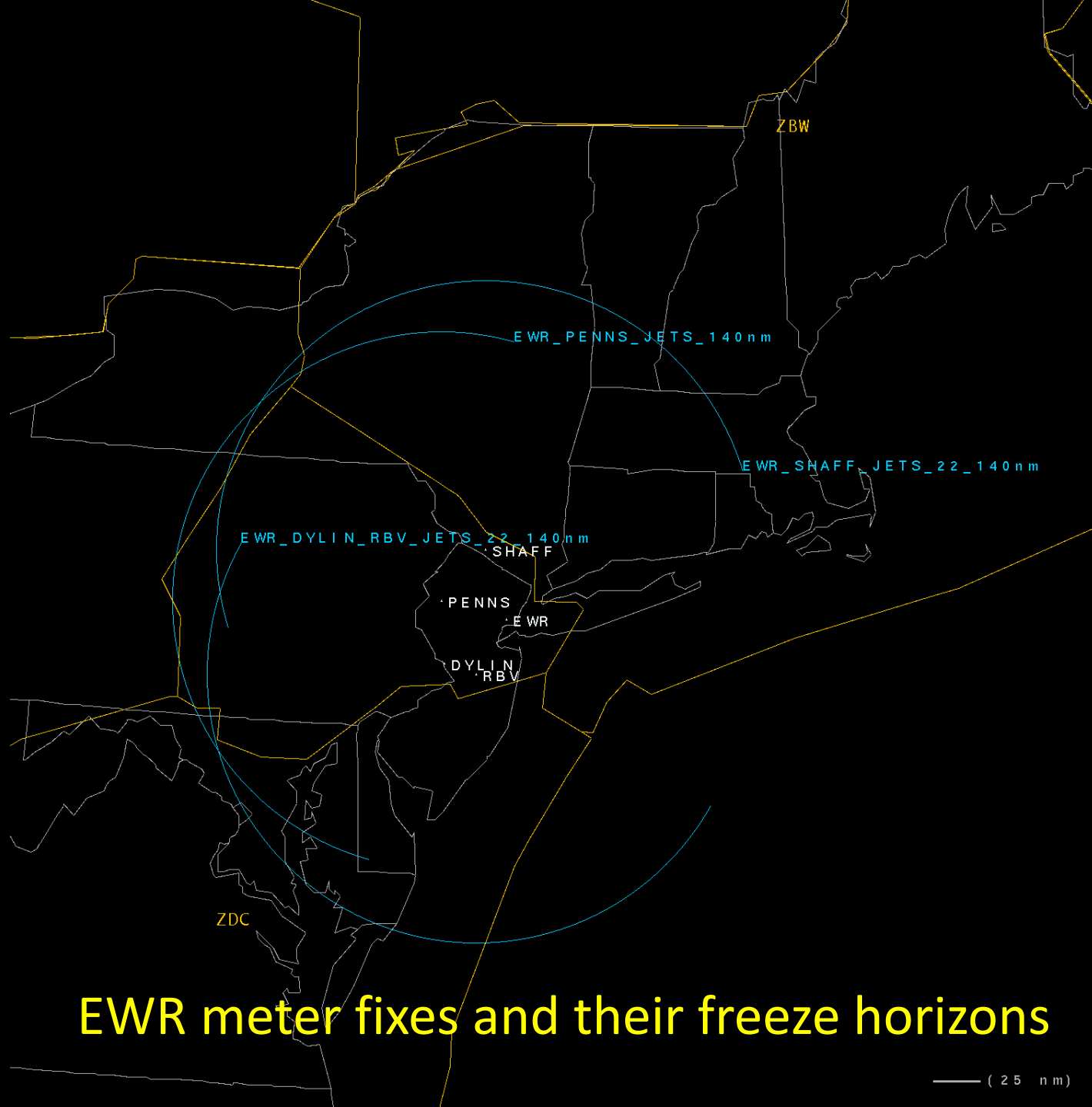
TBFM: Custom IDM Adaptation for EWR

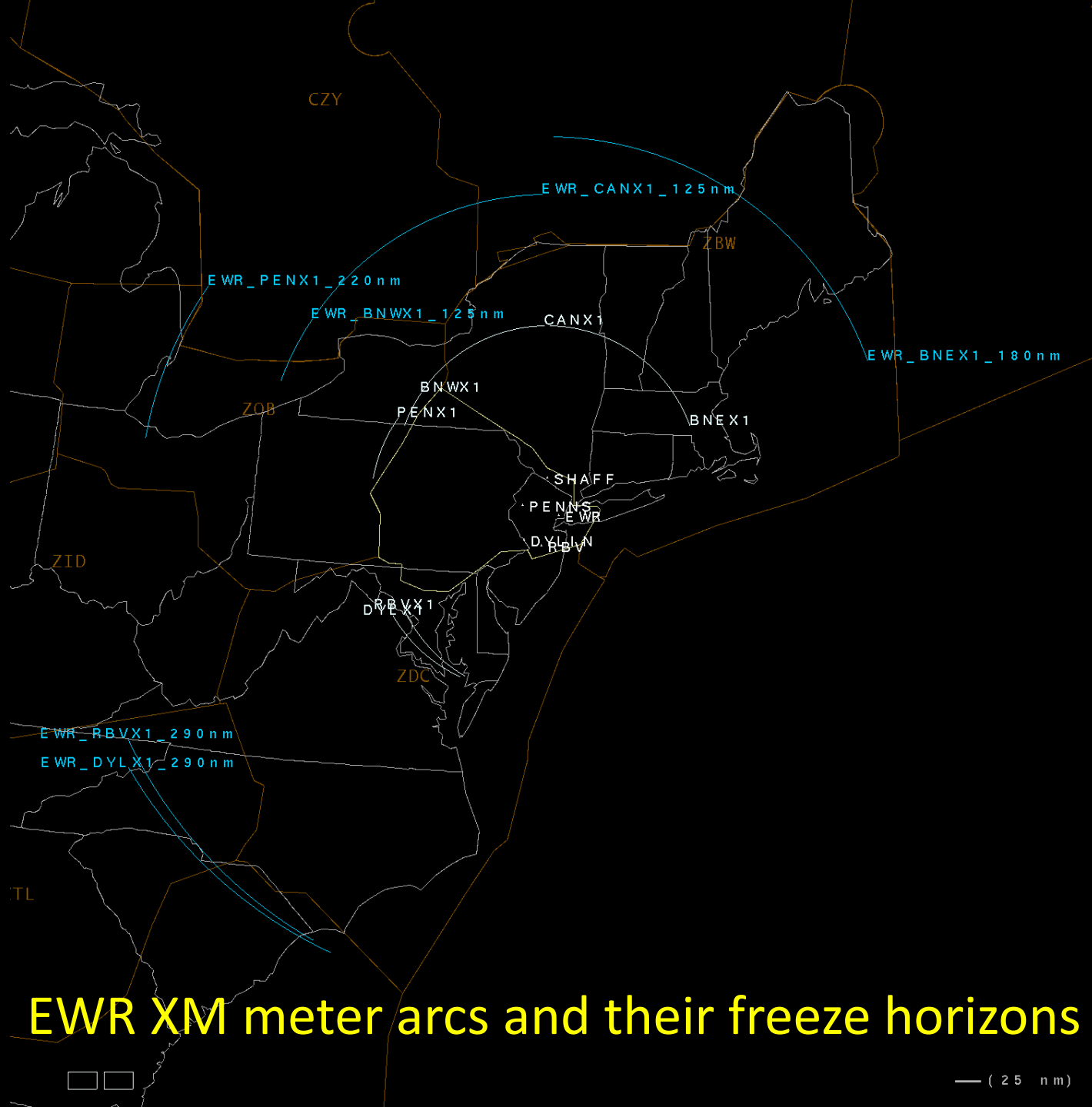


TBFM extended metering (XM) scheduler for all 3 flows (controlled from first tier ARTCCs)

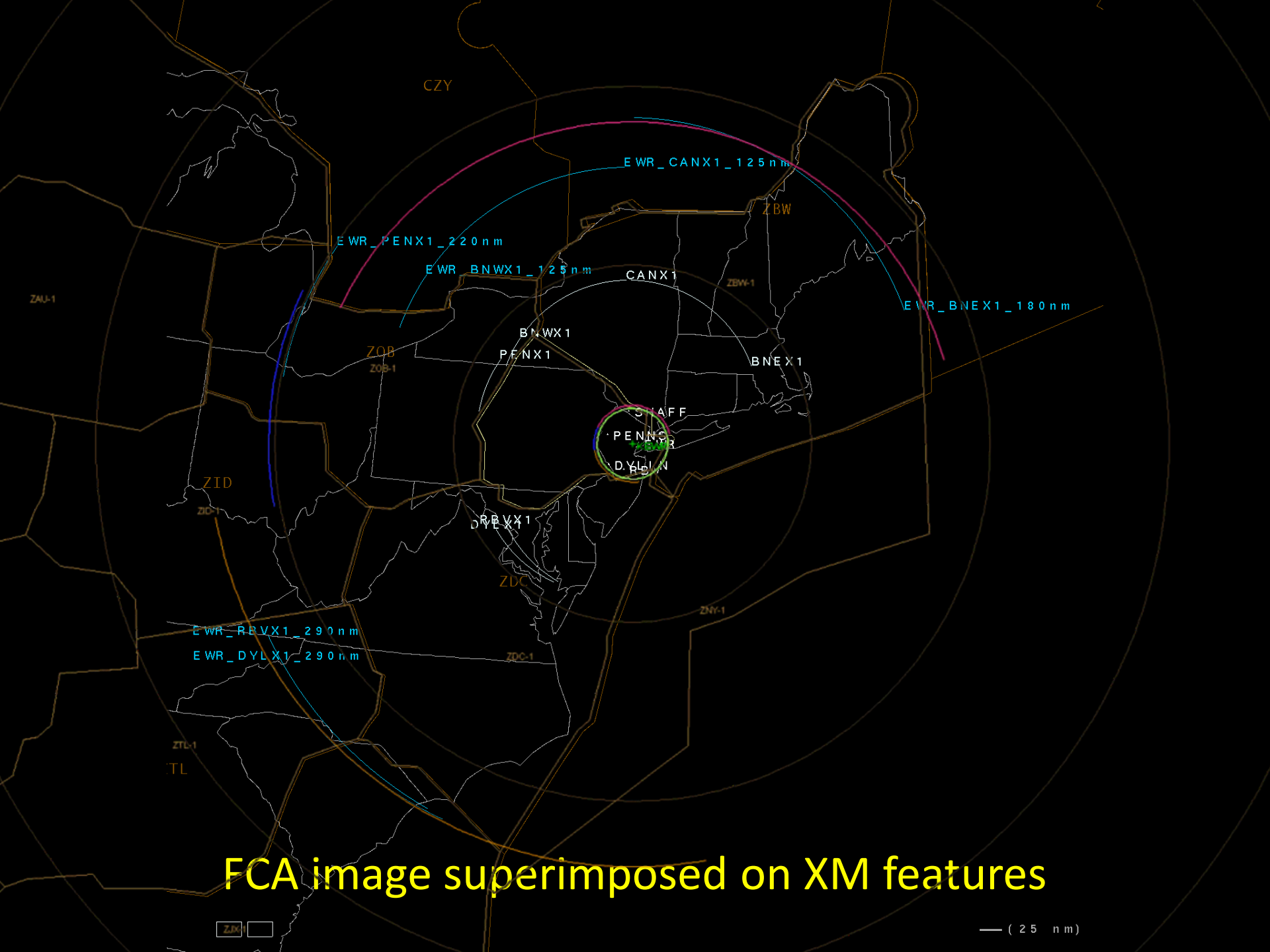
TBFM meter fix (MF) schedule for all 3 flows (controlled from ZNY)





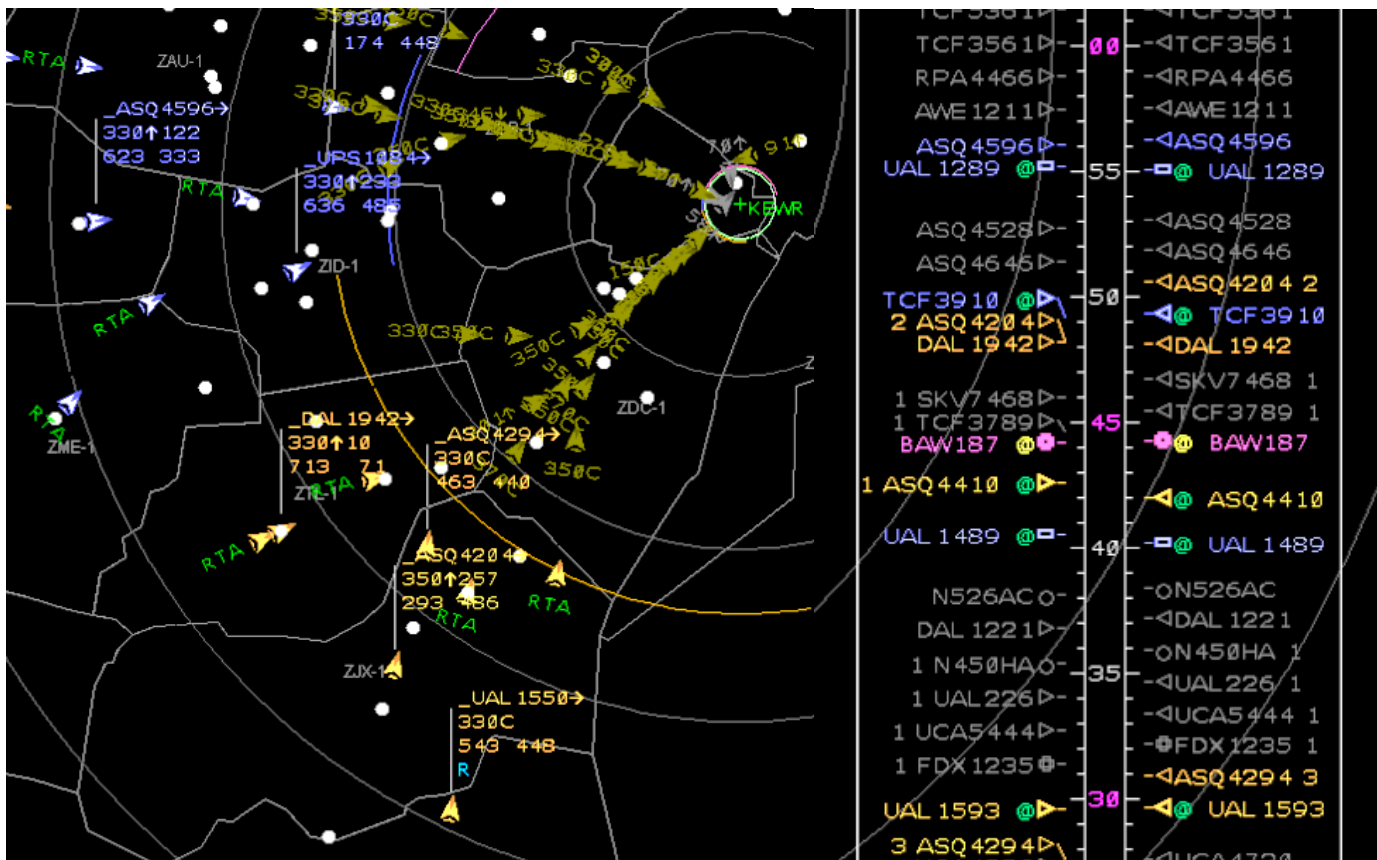


EWR XM meter arcs and their freeze horizons



FCA image superimposed on XM features

RTA Display Features



Topic #2: How is rTA assigned?

- Assuming the target FCA crossing time comes from CTOP, how is it communicated to the flight deck (and others)?
- Two alternatives:
 1. From AOC to flight crew to controller:
 - rTA time accompanies EDCT (pre-departure)
 - Flight strip or data block annotated to indicate rTA status (similar to NRP)
 - What about updates to airborne flights?
 2. From CTOP to controller to flight crew:
 - At this point, Command Center, TMU role unclear; controller's responsibilities unclear. Probably would require a more fleshed out simulation environment to get a handle on this.
- Questions: tools, procedures, roles & responsibilities:
 - *Who needs to know about this, and why? What do they need to know? How do they find that out? Etc...*

Problem: Traffic Volume

- Newark Liberty International Airport routinely experiences traffic demand at or near airport capacity through much of the day. Although this is usually managed effectively using miles-in-trail and TBFM metering, close-in departures can experience excessive and unpredictable ground delay if the overhead flow is saturated.
- IDM is an alternative approach that uses CTOP to match demand to capacity for this “volume” problem.

A solution for the volume problem should provide a framework that can be extended to manage the larger and more dynamic demand-capacity mismatches associated with convective weather.

Traffic Management Objectives for Volume Problem

- Equity across scheduling classes: avoid double penalty or excess ground delay for TBFM-scheduled departures without penalizing external flights
- Throughput: maximize use of available capacity
- Predictability: stable and transparent system for operators
- Operator flexibility: support swapping between all flight types; RTA route/departure time options
- *WITH reasonable workload.*

NY TBO-IDM

New York Trajectory Based Operations
Integrated Demand Management

Training Material

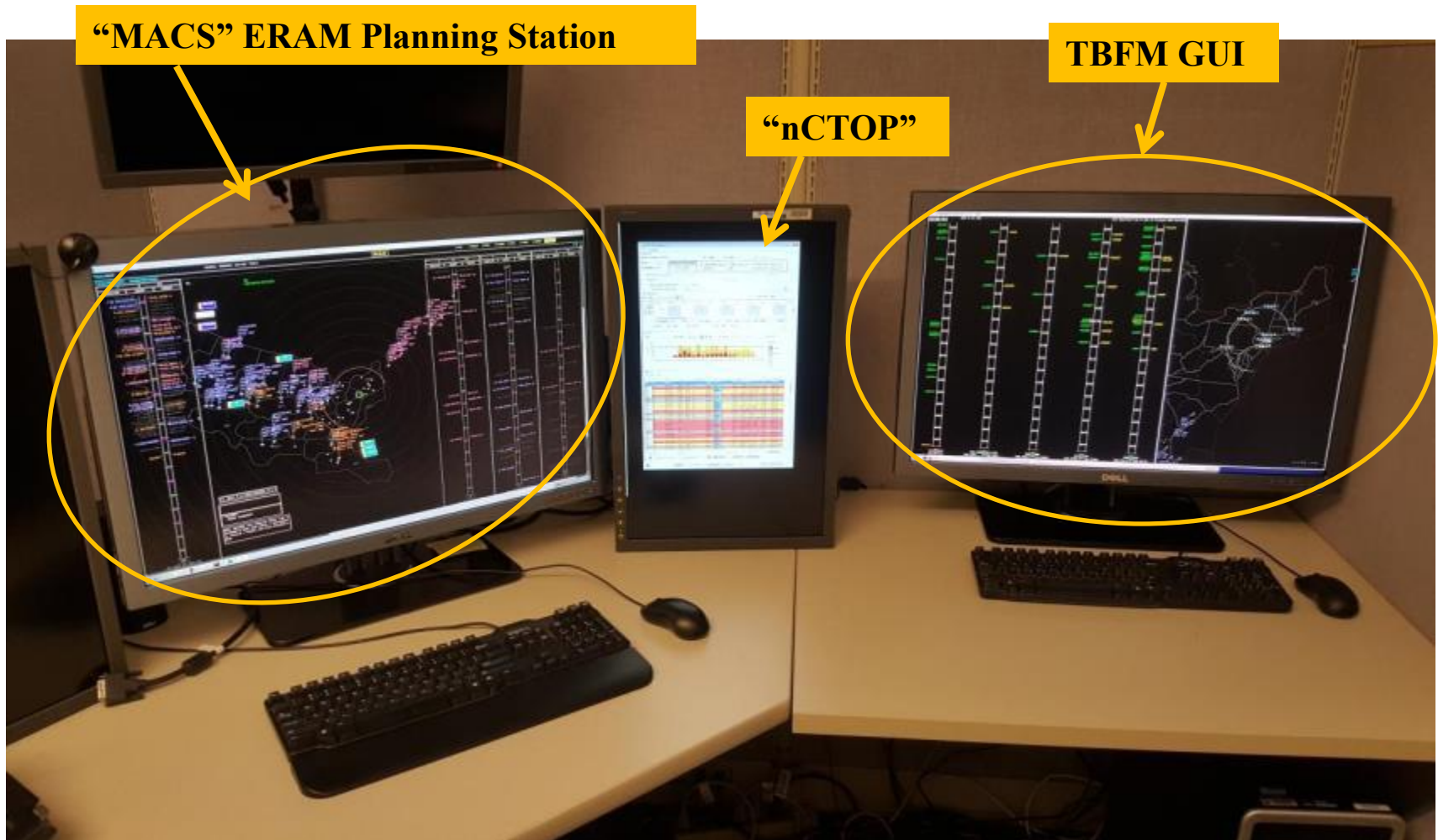
nCTOP Planner & RTA Planner Positions

March 21-25, 2016

- TFMS Technologies
 - Planner Station Set-Up with nCTOP
 - Interactive ERAM Traffic Displays (CTOP FCA Scheduler Timelines & RTA Uplink Capability)
- Tools
 - ERAM Traffic Display
 - Mouse and Map Features
 - Flight Data Block Information
 - Message Composition Area (Like CRD)
 - FCA (RTA) Scheduler Timelines
 - Find and Center Aircraft STA on Timeline (CT)
 - Freeze STA on Timeline to send as RTA
 - Data Link Coordination Capability (UR uplink RTA)
 - Dynamic Aircraft Filter (See Pre-departures)
 - Flow Control Arcs & RTA Schedule Timelines
 - nCTOP
 - Demand and Capacity Tables and Graphs
 - What-If “Model” Capability
 - Sends new schedule based on capacity constraints
 - NEW-Automatic Revision (AR)
 - NEW-Notes Section
 - RTA Planner and AOC RTA positions
 - Communication: Voice (TBFM team to TFMS team) and Data link (RTA)
- TBFM Technologies (not included in this training packet)
 - Internal Departures (ZNY)
 - EDC Departures (ZOB, ZBW, ZDC, ZNY combined)

NY TBO Planner

Workstation and Technologies



ERAM Mouse and Map Features

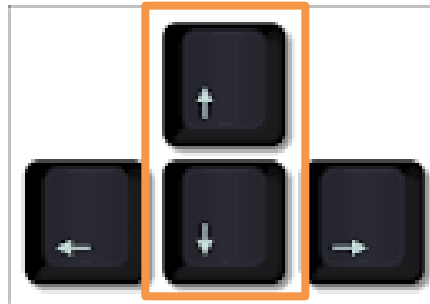


Left Click = PICK (to look and/or drag)

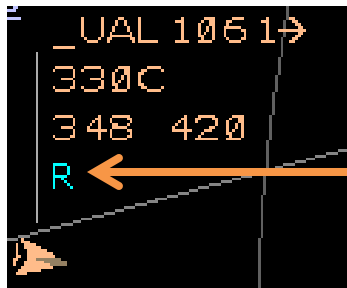
Middle Click (scroll wheel) = ENTER (PICK and ENTER at same time)

Map Movement:

- Zoom: Use up and down arrows on keyboard to zoom in and out
- Move: Middle Click, hold and drag map where you want it



Flight Data Block Info



- Callsign Trial Plan portal arrow (route)
- Altitude
- CID Speed
- RTA Eligibility **R** & **RTA** Feedback Area

ERAM Flight Data Blocks

Flight Data Block

- Color coded by flows (**West**, **South**, **North**)
- Pick on ACID to see Route of flight (QU)
- Middle click on ACID to see Flight Plan (QF)
- Pick anywhere on FDB and drag to move the data blocks around

Data Link: Uplink RTA (UR)

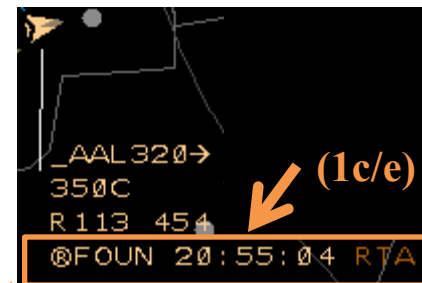
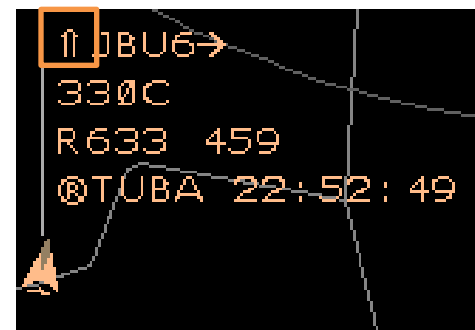
- Uplink Symbol next to ACID
- Data Link Status Area (upper left of ERAM but moveable)
- 4th line fills with RTA information
- FDB collapses when RTA is **good** or **marginal**
- FDB stays full when ground system thinks it is approaching non-compliant and **RTA** goes orange

AID DATA STATUS

JBU6 B737/633 RTA AT TUBAS: 22:52:49 SNT

(1b)

(1a)

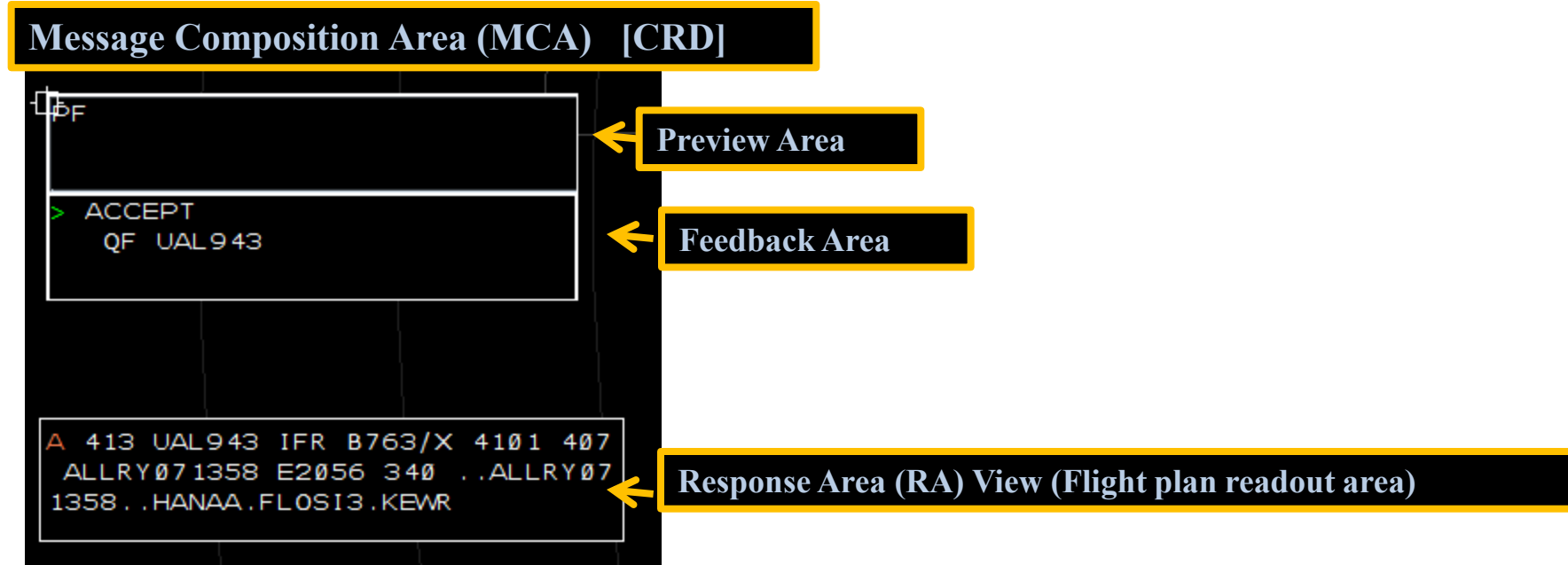


(1c/e)



(1d)

ERAM Message Composition Area (CRD)



Scheduler Timeline Information

Left Information: (ETA)

- Flight Plan Estimated Time of Arrival to the corresponding FCA Arc Schedule

➤ Left Brackets w/ Dwell:
*RTA conformance brackets

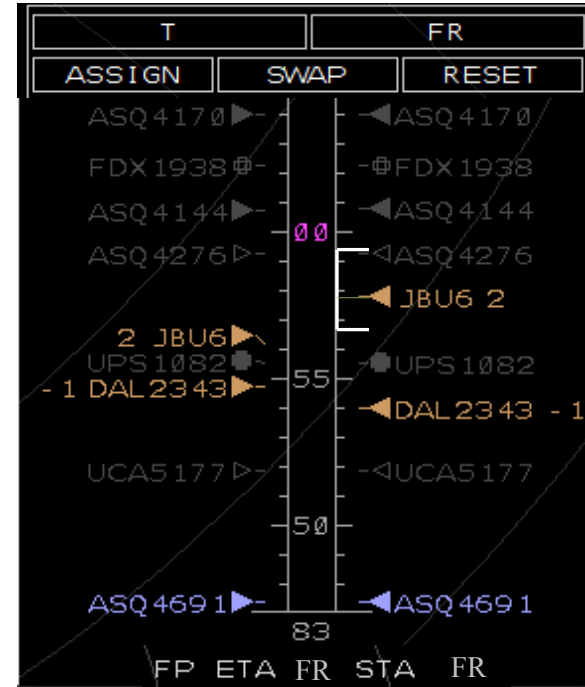
• Dwelling on an aircraft in the timeline (or its data block) will **Highlight** both the datablock and the timeline entry.

Right Information: (STA)

- Scheduled Time of Arrival to the corresponding FCA Arc Schedule

➤ Right Brackets w/ Dwell:
*Shows the spacing requirements at the arc

FR= FCA to 40 Mile Ring



Symbology:

Triangle = Large
Rectangle = 757
Circle = Heavy



Filled = Frozen STA
Hollow = Unfrozen STA

- Color based on flow (South, North, West)**
- Greyed out Pre-departures (STAs are frozen if departure time is 30 minutes from current time)**
- Yellowish Grey are aircraft in TBFM**

FS= Outer FCA for **South** Flow
FW=Outer FCA for **West** Flow
FN=Outer FCA for **North** Flow

| T | FS |
|--------|------|
| ASSIGN | SWAP |
| RESET | |

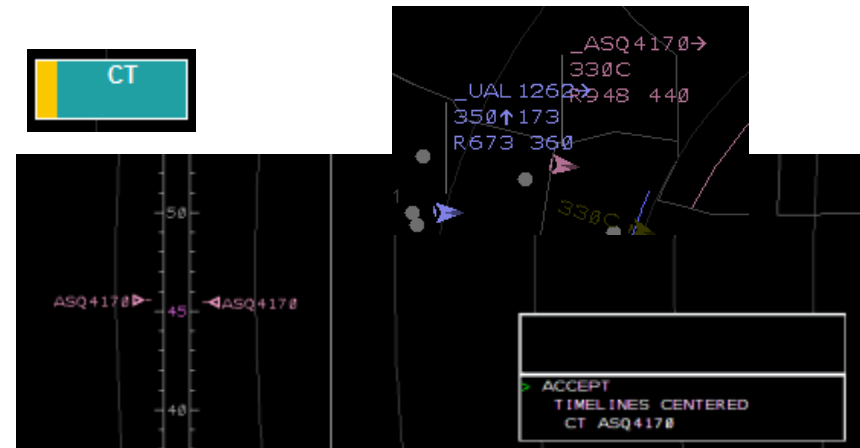
| T | FW |
|--------|------|
| ASSIGN | SWAP |
| RESET | |

| T | FN |
|--------|------|
| ASSIGN | SWAP |
| RESET | |

Scheduler Timeline Information (cont.)

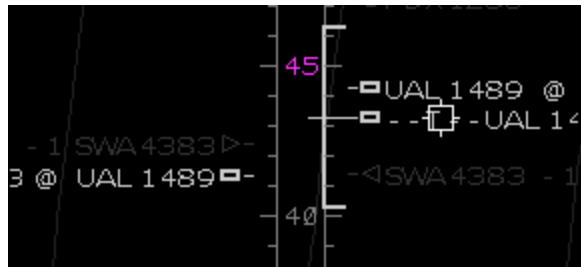
Find and Center ACID on Timeline (CT)

- Type CT or Pick on CT Macro
- Middle click AC target symbol (Chevron) or [CID]
- Timeline will center at ACIDs STA



If needed, Manual Freeze AC in Timeline

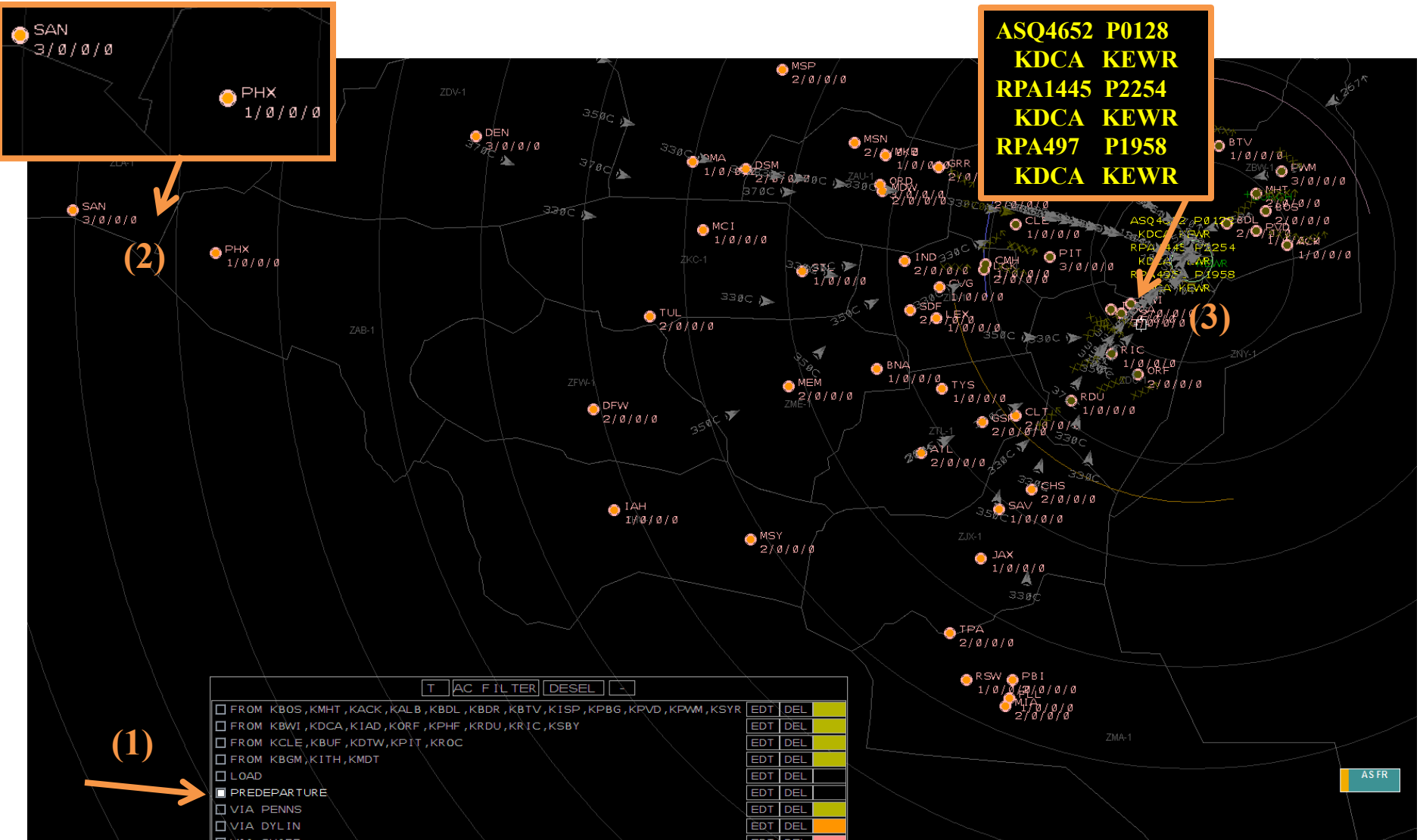
- Pick (Left click) on ACID STA side (turns white)
- Drag if needed to move up or back
- Preview Area will pre fill with AS FW 19:43:16 UAL 1489
- Type /OK hit [ENTER] (Symbol will become solid)



AS FW 19:43:16 UAL 1489 /OK

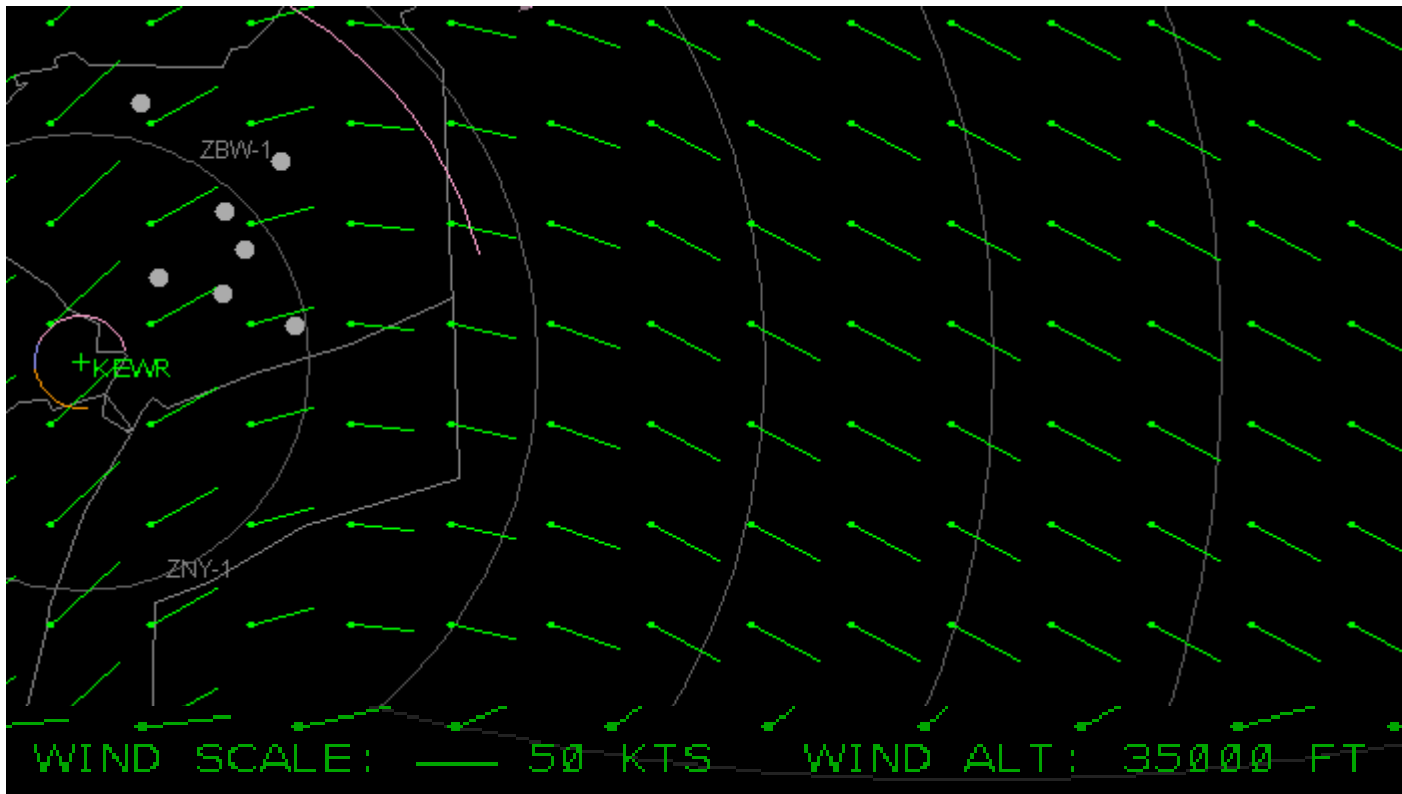
[See All Pre-Departures: AC Filter](#)

- 1. Pick on PREDEPARTURE Button in AC Filter**
- 2. All Airports are displayed with how many PREDEPARTURES 3/0/0/0**
- 3. Dwell on # (3) and list of PREDEPARTURES appears with scheduled P-times**

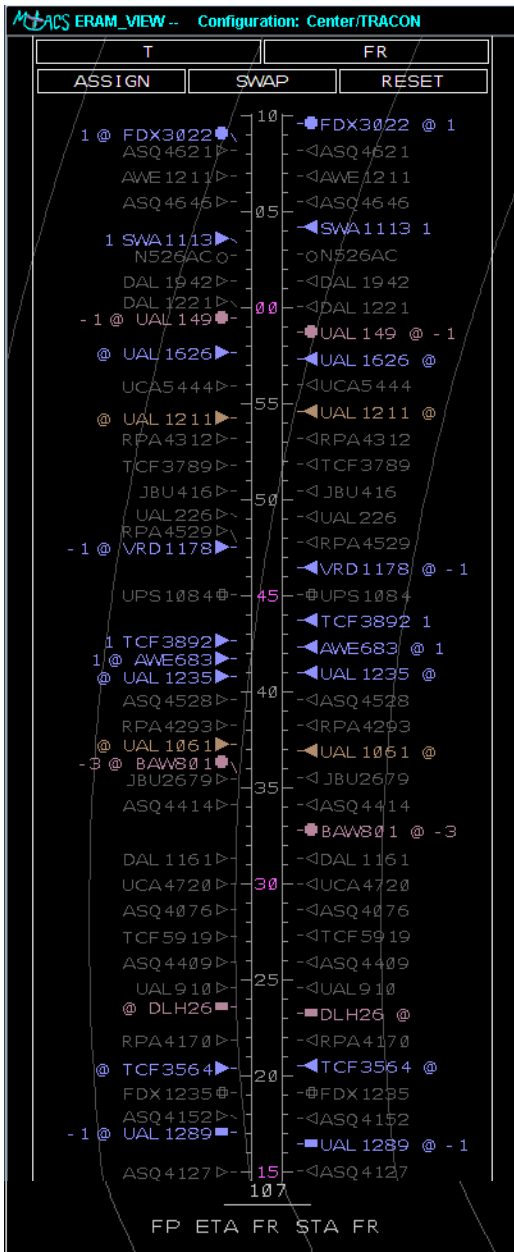


WINDS [WV FL]

- All conditions have same wind
 - actual and forecast winds differ (~10-40 kt RMS error)
- Use WV: Wind Vector command to display *forecast* winds:
 - **WV <Flight Level>** (e.g, to display winds at 29000,' use [WV 290])
 - WV alone turns wind vectors off
 - Shows Point of Origin and Direction Blowing with a 50kts scale at bottom of screen



ERAM FCA Schedulers & nCTOP



FCA Schedule & nCTOP set-up options

- **Single FCA Ring (FR)**
 - All 3 flows combined (FW, FN, FS)
 - Equal Distribution of capacity based on airport arrival rate (AAR)
 - 40 AAR = 10 capacity value in each 15 min bin
- **2-FCA Arcs South Inner FCA and West/North Inner combined (SIF and WNIF)**
 - South flow set capacity manually per hour or 15 min. bin
 - West and North flows are now combined set capacity manually per hour or 15 min. bin
 - Or, NEW Algorithm (**not in current CTOP**) does auto binning by setting capacity values based on the demand across each flow.
 - 40 AAR = capacity distributed automatically across each flow based on demand
- **3-FCA Arcs South Inner, West Inner, & North Inner FCA Arcs (SIF, WIF, NIF)**
 - 3 separate inner FCA ARCs across each flow
 - Can manually set capacity across each flow individually (best guess)
 - Or, NEW Algorithm (**not in current CTOP**) does auto binning by setting capacity values based on the demand across each flow.
 - Can restrict one flow to solid rate, then new algorithm can auto distribute the rest of the slots across the other 2 flows.

NY TBO Planner ERAM Traffic Display

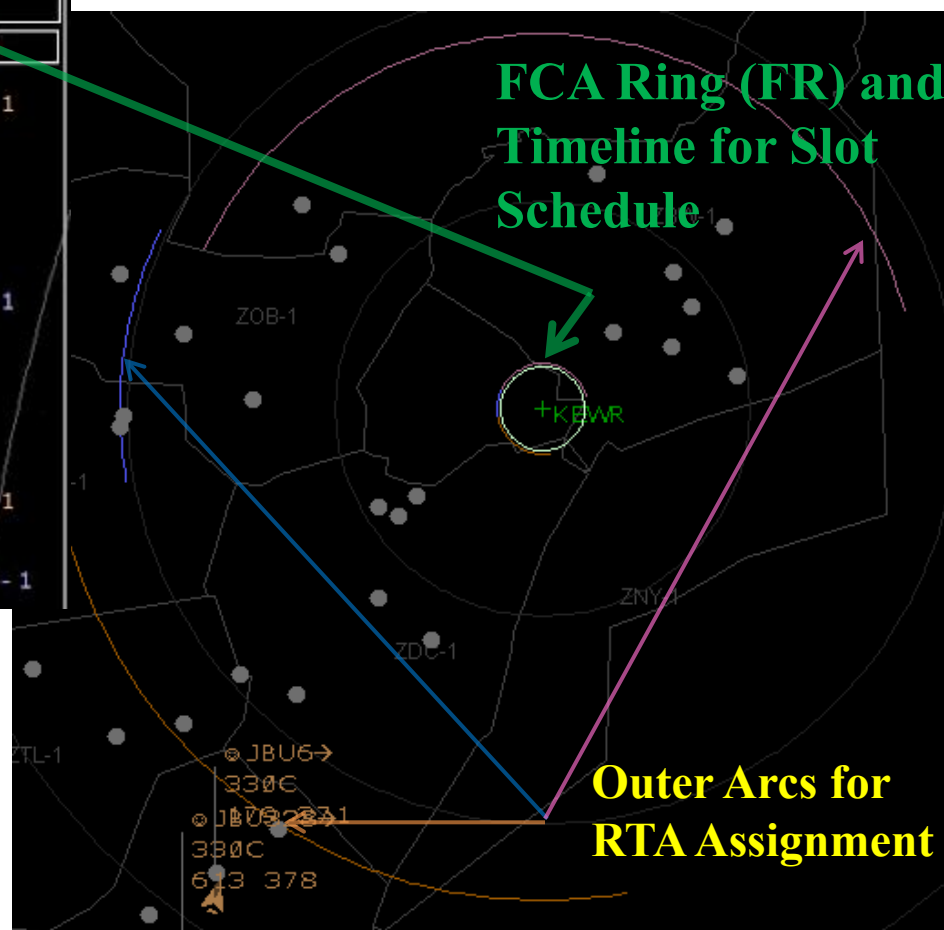
Single Inner FCA Ring (FR)

West flow: Blue (PENNS)

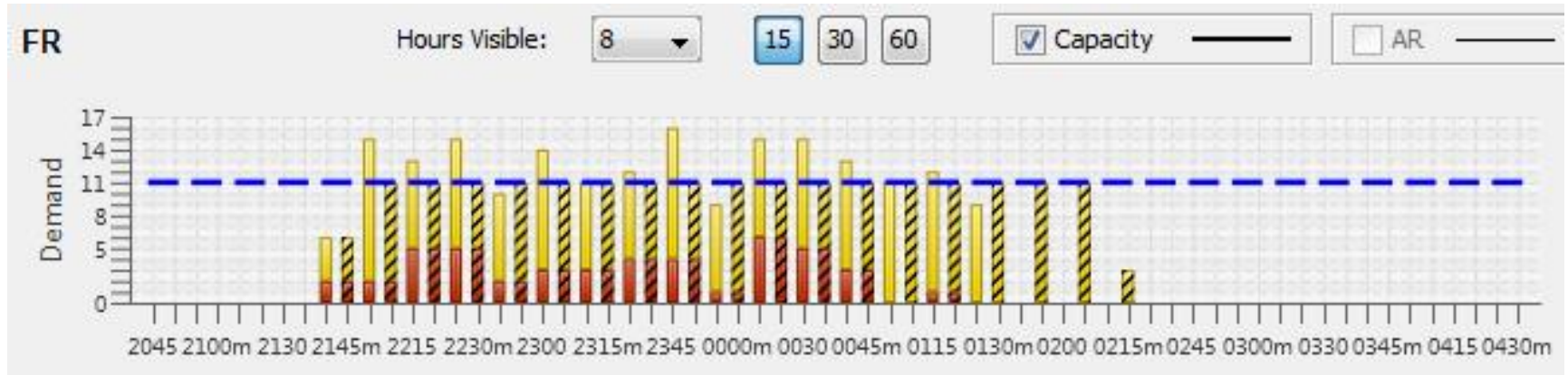
South flow: Orange (DYLIN)

North flow: Pink (SHAFF)

| ML | T | FR |
|--------------|------|----------------|
| ASSIGN | SWAP | RESET |
| 1 @ UAL 1211 | 50 | ← UAL 1211 @ 1 |
| ASQ5830 | | ← ASQ5830 |
| UPS1084 | | ← UPS1084 |
| ASQ4076 | | ← ASQ4076 |
| N450HA | 45 | ← ON450HA |
| 1 @ UAL 1626 | | ← UAL 1626 @ 1 |
| TCF3892 | | ← TCF3892 |
| RPA4952 | 40 | ← RPA4952 |
| @ BAW187 | | ← BAW187 @ |
| JBU2679 | | ← JBU2679 |
| 1 @ UAL 1061 | 35 | ← UAL 1061 @ 1 |
| DAL 1161 | | ← DAL 1161 |
| -1 @ VRD1178 | | ← VRD1178 @ -1 |



Model for 1 FCA Ring (FR) (44 rate)



Setting the FCA Schedule: nCTOP Planner

Single Inner FCA Ring (FR)

- Set nCTOP FCA Parameters
 - Set Capacity Value (per 15 in bin) for FR
 - **Model** new settings
- ERAM FR Scheduler
 - Give In-flight Preference (**IFP FR /OK**) (Exempt and Freeze on TL)
- nCTOP
 - Send Actual capacity values per flow to ERAM FCA Scheduler
- ERAM FR Scheduler
 - Move Slots to close minor gaps (**MS FR /OK**)
 - Send New Slot (Schedule) Departure Times (**AP FR ALL /OK**)

2-FCA Inner Arcs (WNIF and SIF)

| T | WNIF |
|--------------|---------------|
| ASSIGN | RESET |
| 3 JBU2679▷ | -◁JBU2679 3 |
| 2 TCF3910▷ | -◁TCF3910 2 |
| DAL 1161▷ | -◁DAL 1161 |
| - 1 ASQ4414▷ | -◁ASQ4414 - 1 |
| 1 TCF5919▷ | -◁TCF5919 1 |
| 1 SWA4383▷ | -◁SWA4383 1 |
| BAW187 ◉ | -◉BAW187 |
| UAL994▷ | -◁UAL994 |
| UAL 1489▷ | -◁UAL 1489 |

| T | SIF |
|--------------|---------------|
| ASSIGN | RESET |
| RPA4952▷ | -◁RPA4952 |
| - 1 N450HAO- | -◁N450HA - 1 |
| UCA4720▷ | -◁UCA4720 |
| - 1 ASQ4294▷ | -◁ASQ4294 - 1 |
| ASQ4076▷ | -◁ASQ4076 |
| SWA45▷ | -◁SWA45 |
| ASQ4410▷ | -◁ASQ4410 |
| ASQ4152▷ | -◁ASQ4152 |

WNIF combined West & North

- **West flow: Blue (PENNS)**
- **North flow: Pink (SHAFF)**

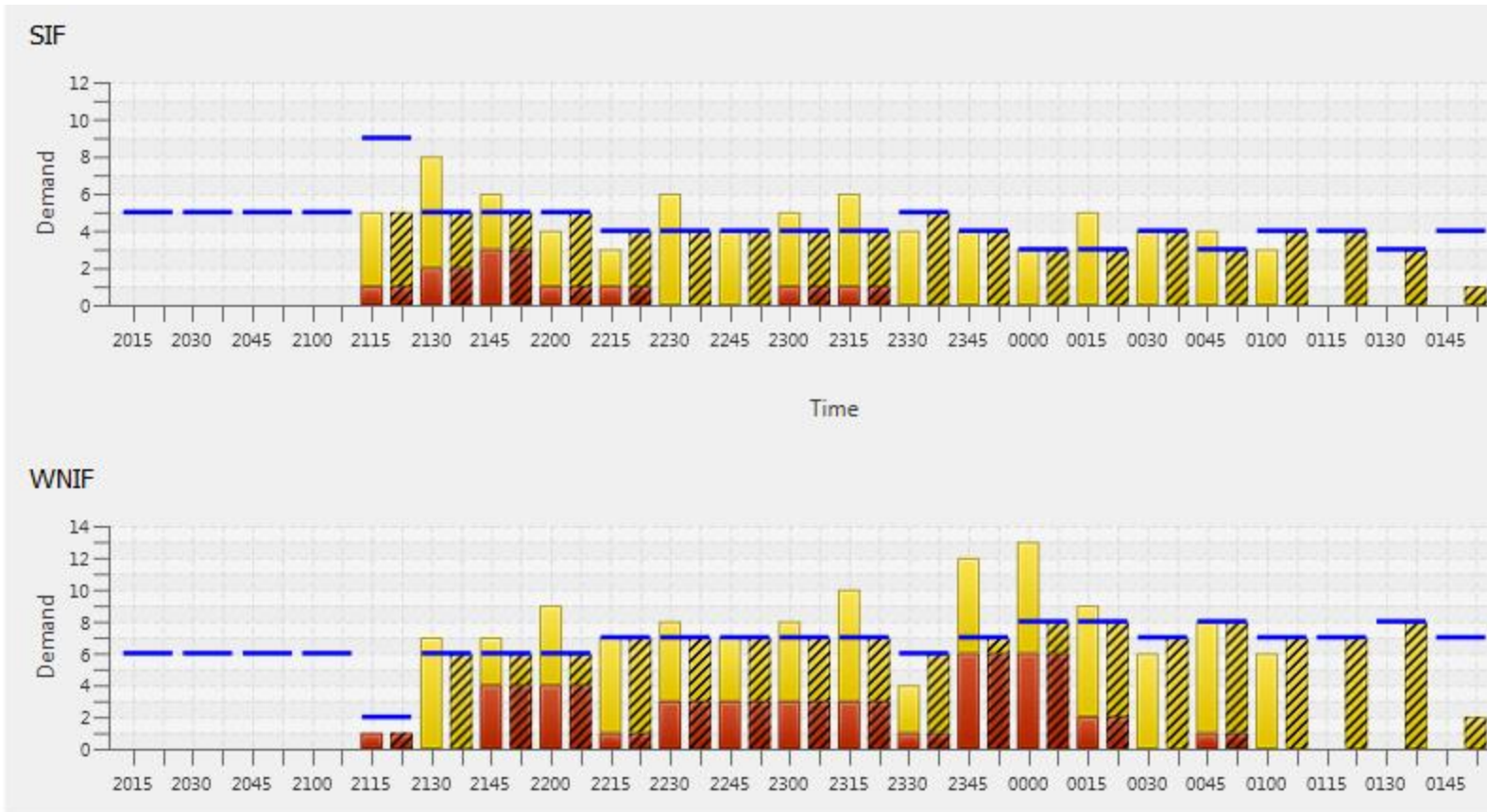
SIF:

- **South flow: Orange (DYLIN)**

2-FCA Arcs and Timelines for each Slot Schedule

Outer Arcs for RTA Assignment

Model for 2-Arc with new* auto binning ON (44 rate)



* Note: New Algorithm not in current CTOP

Setting the FCA Schedule: nCTOP Planner

2-Inner ARC FCA (WNIF and SIF)

- Set nCTOP FCA Parameters Manually or for CTOP_Combined (WNIF + SIF)
 - Set Capacity Value as 44 for 60 min or 11 for 15 min bin
 - New Algorithm will automatically calculate the capacity values for each (2) FCA based on the demand
 - Or, you can manually set capacity across each FCA per 15 min bin
 - Or, Set Capacity Value for restricted south flow (4/15 min bin) and then 7 for the combined FWNI Arc (#s assume 44 rate)
 - Model new settings
- ERAM FCA Arc Schedules
 - Give In-flight Preference (IFP SIF /OK) (IFP WNIF /OK)
 - Exempts In-flights and Freezes them on TL
- nCTOP
 - Send Actual (capacity to ERAM FCA Arc Schedulers)
- ERAM FCA Arc Schedules adjust to capacity settings
 - Move Slots to close minor gaps (**MIS SIF 1 /OK & WNIF /OK**)
 - Send New Slot (Schedule) Departure Times (**AP SIF ALL /OK & WNIF ALL /OK**)



SIF: South flow: Orange (DYLIN)

3-FCA Arcs and Timelines for each Slot Schedule

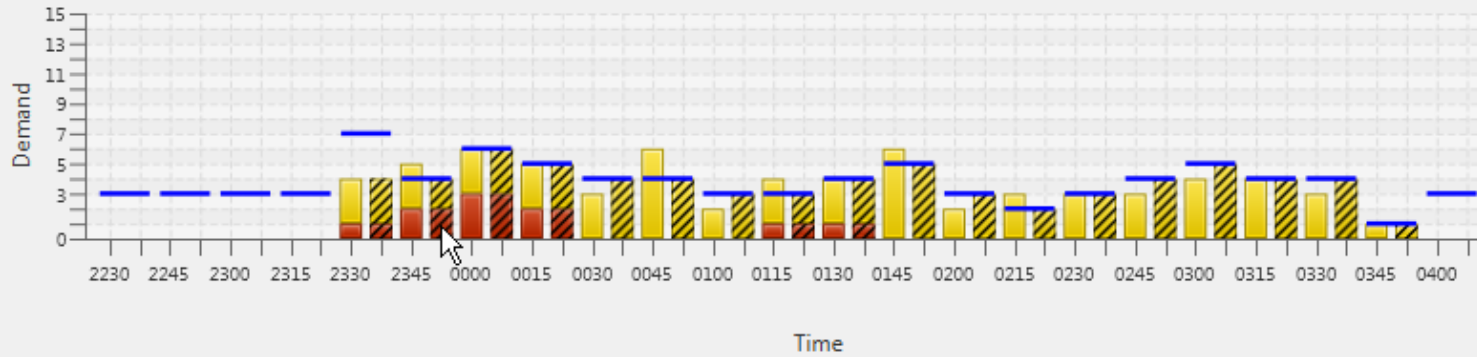
Outer Arcs for RTA Assignment

Diagram illustrating the 3-FCA Arcs and Timelines for each Slot Schedule. The diagram shows a central airport (KEWR) with concentric arcs representing flight paths. Labels include ZOB-1, ZBW-1, ZNY-1, ZDC-1, ZID-1, and JBUG. A legend indicates 'Outer Arcs for RTA Assignment'.

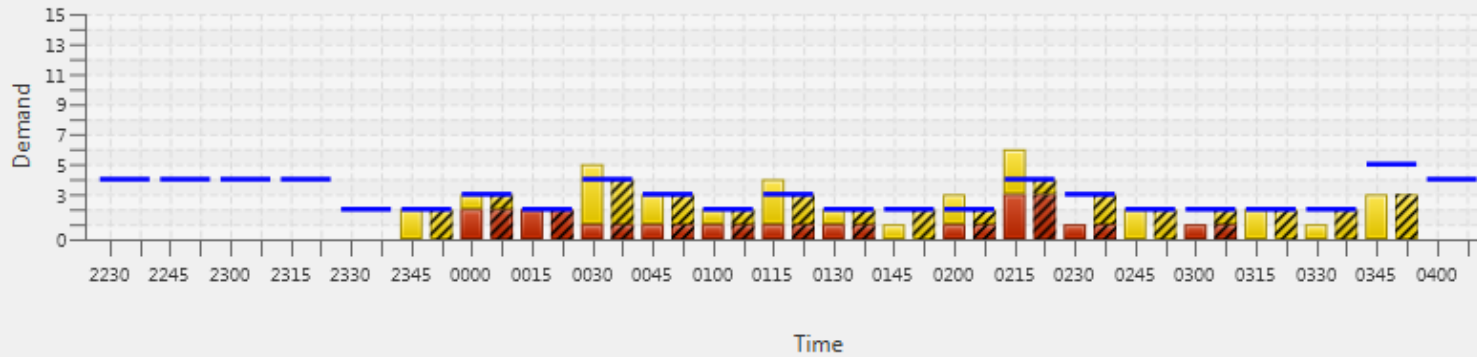
Outer Arcs for RTA Assignment

Model for 3-Arc with new* auto binning ON (44 rate)

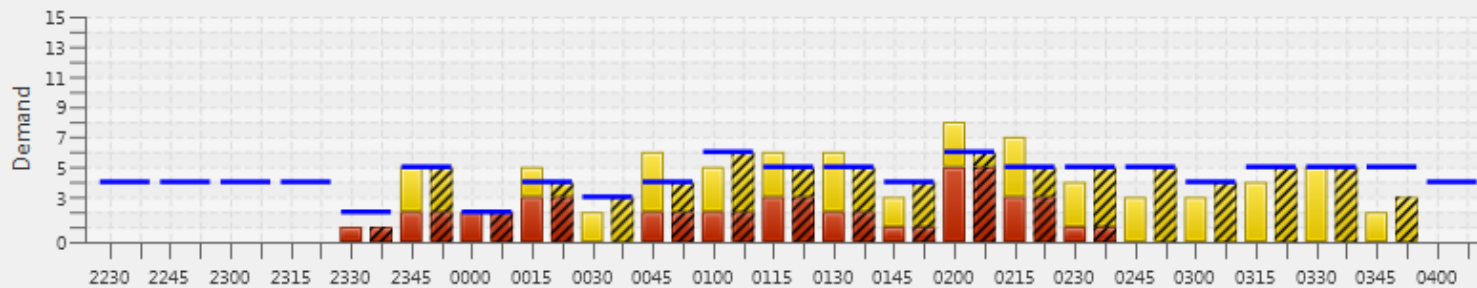
FSI



FNI



FWI



* Note: New Algorithm not in current CTOP

Setting the FCA Schedule: nCTOP Planner

3-Inner ARC FCA (WIF, NIF and SIF)

- Set nCTOP FCA Parameters Manually or for CTOP_Combined (WIF,NIF + SIF)
 - Set Capacity Value as 44 for 60 min or 11 for 15 min bin
 - New Algorithm will automatically calculate the capacity values for each (3) FCA based on the demand
 - Or, you can manually set capacity across each FCA per 15 min bin
 - Or, Set Capacity Value for restricted south flow (4/15 min bin) and then 7 for the combined WIF & NIF Arcs manual or automated distribution of capacity (#s assume 44 rate)
 - Model new settings
- ERAM FCA Arc Schedules
 - Give In-flight Preference (**IFP SIF /OK**) (**IFP WIF /OK**) (**IFP NIF /OK**)
 - Exempts In-flights and Freezes them on TL
- nCTOP
 - Send Actual (capacity to ERAM FCA Arc Schedulers)
- ERAM FCA Arc Schedules adjust to capacity settings
 - Move Slots to close minor gaps (**MIS SIF 1 /OK**) (**MIS WIF 1 /OK**) (**MIS NIF 1 /OK**)
 - Send New Slot Departure Times (**AP SIF ALL /OK**) (**AP WIF ALL /OK**) (**AP NIF ALL /OK**)

nCTOP Display

nCTOP Display

- Parameters
 - Automatic Revision
- FCA Parameters
 - Demand Information
 - Capacity Settings
 - AR_Above
 - AR_Below
- Bar Chart
- Flight List
 - Red Active
 - Yellow Inactive Externals
 - Grey Inactive Internals
 - Blue STA Frozen Status

Parameters

Name: CTOP009 NASA134 Start: 0000 End: 0000 Purge Program

Rank: 1 Change... Automatic Revision (AR): Look-Ahead: 3 hrs Offset: 1 hr Refresh Interval: 30 min Smoothing Factor: 45 min

Total Flights: 334

FEA/FCAs: FS,FW,FN,FR Draw Add/Remove

Exemptions: Apply Exemption

Exempt all flights departing within 45 minutes

Pop-Up Delay Limit (minutes): 180 Default

FCA Parameters

View: FR 15 60 Model Time: 2201

Time: 2200 2215 2230 2245 2300 2315 2330 2345 0000 0015

Demand: 0 0 0 0 5 11 10 12 16 16

Capacity: 12 12 12 12 12 12 12 12 12 12

AR_Above: AR_Below:

Fill: Capacity With: From: 2200 Through: 2215 Fill Fill All Reset

FEA/FCA: Start: 2200 End: 0300 Ceiling: 600 Floor: 0 Edit...

Bar Chart

FR Hours Visible: 8 15 30 60 Capacity AR Merge flows

Demand

Time

Flight List

FR (COUNT: 194)

| # | FCA | ACID | BETD | CTD | Ground Delay | ETA | STA | Sch. Delay | Current RTE | ORIG | DSC item # |
|-----|-----|---------|------|------|--------------|------|------|------------|---------------------------|-------|------------|
| 001 | FR | JBU6 | - | - | - | 2303 | 2303 | 0 | KFLL//MUTAL197054..N... | KFLL | ZBW_01 |
| 002 | FR | ASQ4276 | 2215 | 2215 | 0 | 2305 | 2306 | 0 | KGSO//SBV..CREWE.351... | KGSO | ZBW_01 |
| 003 | FR | N4675H | 2204 | 2204 | 0 | 2311 | 2311 | 0 | KLEX//MOL..GVE..PHLBO... | KLEX | ZBW_01 |
| 004 | FR | 5KV7007 | 2232 | 2232 | 0 | 2312 | 2312 | 0 | CYYZ//ATRCO..GFE..FLO... | CYYZ | ZBW_01 |
| 005 | FR | ASQ4672 | 2202 | 2202 | 0 | 2313 | 2313 | 0 | KCHS//GINNE..FLO.355... | KCHS | ZBW_01 |
| 006 | FR | ASQ4352 | 2202 | 2202 | 0 | 2315 | 2315 | 0 | KCVG//DIRKE..DJB.329... | KCVG | ZOB_01 |
| 007 | FR | UAL1116 | 2244 | 2244 | 0 | 2315 | 2316 | 0 | KBOS//PATSS..NELIE.F... | KBOS | ZBW_01 |
| 008 | FR | UAL237 | 2215 | 2215 | 0 | 2318 | 2318 | 0 | KMYR//FAK..PHLBO3..KEWR | KMYR | ZBW_01 |
| 009 | FR | RPA4808 | 2242 | 2242 | 0 | 2317 | 2320 | 0 | KIAD//FASER..GEPRO.... | KIAD | ZBW_01 |
| 010 | FR | UPS1082 | 2203 | 2203 | 0 | 2321 | 2321 | 0 | KSDF//COLMU..DORET.... | KSDF | ZOB_01 |
| 011 | FR | JBU328 | - | - | - | 2321 | 2322 | 0 | KMCO//SSI098044..PAI... | KMCO | ZBW_01 |
| 012 | FR | N468PU | 2220 | 2220 | 0 | 2324 | 2324 | 0 | KORR//COOIB..ERI..TD... | KORR | ZOB_01 |
| 013 | FR | UAL1262 | 2203 | 2203 | 0 | 2326 | 2326 | 0 | KORD//DUFEE..ELX..HA... | KORD | ZOB_01 |
| 014 | FR | UCA4775 | 2257 | 2257 | 0 | 2324 | 2327 | 0 | KBWI//SWANN..RUUTH1..KEWR | KBWI | ZBW_01 |
| 015 | FR | UAL943 | - | - | - | 2328 | 2328 | 0 | EGLL//YY0810026..ZON... | EGLL | ZBW_01 |
| 016 | FR | TCF3556 | 2216 | 2216 | 0 | 2330 | 2330 | 0 | KIND//BDOCK..SERIE.... | KIND | ZOB_01 |
| 017 | FR | AAL320 | - | - | - | 2329 | 2332 | 0 | KDFW//GHH094010..TKK... | KDFW | ZBW_01 |
| 018 | FR | 5MA45 | - | - | - | 2332 | 2333 | 0 | KHOU//BNA240064..HAR... | KHOU | ZBW_01 |
| 019 | FR | UCA5177 | 2314 | 2314 | 0 | 2334 | 2334 | 0 | KBDL//NELIE..FLOS13..KEWR | KBDL | ZBW_01 |
| 020 | FR | ASQ4301 | 2209 | 2209 | 0 | 2337 | 2337 | 0 | KPIKE//SQUB..PRG..EC... | KPIKE | ZBW_01 |
| 021 | FR | UAL1492 | 2215 | 2215 | 0 | 2337 | 2337 | 0 | KORD//DUFEE..ELX..HA... | KORD | ZOB_01 |

Filter: From: Through: Customize Columns... Advanced Sort... Refresh ETD

Show Current Route Show Assigned Route

Flight Search Flight Info Flight History

Model Send Proposed Send Actual Reset Cancel

note IFP MS AP

Set ARR for FCA and Freeze All Inflight (IFP)

➤ **Look at nCTOP and set capacity bins to build the FCA criteria**

1. defaults to a 12 capacity every 15 minute bin or ~48 ARR
2. Set knew capacity bins to go to 44 ARR or 11 aircraft per 15 min. bin
3. Model this to see how it looks
4. If looks good then you
 - a) Give in-flight preference on FR scheduler to preserve their soft CTA position
(Type **IFP FR /OK** or click IFP FR macro on ERAM display)
 - b) Send Actual capacity data to MACS to build slot schedule

FCA Parameters

View: FR 15 60 Model Time: 2202

| Time: | 2200 | 2215 | 2230 | 2245 | 2300 | 2315 | 2330 | 2345 | 0000 | 0015 |
|-----------|------|------|------|------|------|------|------|------|------|------|
| Demand: | 0 | 0 | 0 | 0 | 5 | 11 | 10 | 12 | 16 | 16 |
| Capacity: | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| AR_Above: | | | | | | | | | | |
| AR_Below: | | | | | | | | | | |

Fill: Capacity With: 11 From: 2200 Through: 2215 Fill Fill All Reset

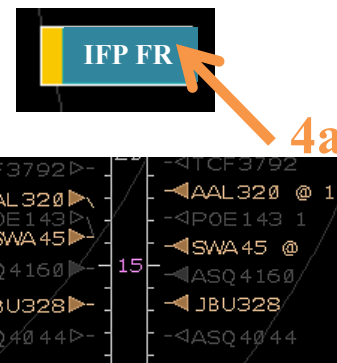
FEA/FCA: Start: 2200 End: 0300 Ceiling: 600 Floor: 0 Edit...

Bar Chart

FR Hours Visible: 8 15 30 60 ☒ Capacity ☐ AR ☐ Merge flows

☒ ALL ☐ Routed Out ☒ All Other ☐ NC Demand ☐ CTD

Model Send Proposed Send Actual Reset Cancel note IFP MS AP



Send New SDTs (AP)

➤ Look at FR Scheduler to see impact of new capacity settings and send new SDTs

1. If all looks good in FR schedule you need to close up any gaps in schedule and issue new slot departure times (SDT or p-times)
 - a) Type **MS FR /OK**
 - b) Type **AP FR ALL /OK**
 - c) You will see all ETAs match STAs for unfrozen Pre-departure flights (greyed out)
 - d) All Predeparture STAs will be frozen if they are within 30 minutes of departure (Filled in symbol means frozen)

The screenshot displays the FR Scheduler interface. On the left, a command input field contains the text "AP FR ALL /OK", with an orange arrow labeled "(1b)" pointing to it. On the right, a list of flight data is shown, including flight numbers, times, and status indicators. An orange arrow labeled "(1c)" points to a specific row in the flight data list. At the bottom, another orange arrow labeled "(1b)" points to a row in the flight data list.

| Flight | Time | Status |
|------------|------|--------|
| SKV7468 | 30 | (1c) |
| ASQ4410 | | |
| TCF3910 | | |
| N526AC | 25 | |
| N450HA | | |
| UCA5444 | | |
| @ UAL 1289 | 20 | |
| FDX1235 | | |
| UAL1593 | | |
| ASQ4294 | 15 | |
| UCA4720 | | |
| UPS1084 | | |
| ASQ4414 | 10 | |
| ASQ5337 | | |

Automatic Revision Set-Up

➤ Look at nCTOP Parameters: Automatic Revision (AR)

1. Turn AR ON
2. Set AR_Above and AR_Below
3. Set Refresh Interval and Smoothing Factor
4. Set Look-Ahead and Offset

nCTOP v0.65 (Master) [distributed idm rta]

Model: CTOP-ALL

Parameters

Name: CTOP006 NASA134 Start: 0000 End: 0000 Purge Program

Rank: 1 Change... Automatic Revision (AR):

Total Flights: 310 On Off

Look-Ahead: 3 hrs Offset: 1 hr

Refresh Interval: 30 min. Smoothing Factor: 45 min.

FEA/FCAs: FS, FW, FN, FR Draw Add/Remove

Exemptions: Apply Exemption

Exempt all flights departing within 45 minutes.

Pop-Up Delay Limit (minutes): 180 Default

FCA Parameters

View: FR 15 60 Model Time: 1950

| Time: | 1945 | 2000 | 2015 | 2030 | 2045 | 2100 | 2115 | 2130 | 2145 | 2200 |
|-----------|------|------|------|------|------|------|------|------|------|------|
| Demand: | 0 | 6 | 10 | 10 | 11 | 11 | 12 | 11 | 11 | 11 |
| Capacity: | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| AR_Above: | | | | | | | | | | |
| AR_Below: | | | | | | | | | | |

Fill Capacity With: 11 From: 1945 Through: 2000 Fill Fill All Reset

FEA/FCAs: FS, FW, FN, FR End: 0015 Ceiling: 600 Floor: 0 Edit...

Automatic Revision Set-Up (Cont.)

➤ Automatic Revision (AR) Trigger for FCA “FR”

1. Note that the AR_Above and AR_Below was set very low to get the trigger in this traffic
2. Note that the Refresh Interval and Smoothing Factors were set very low as well
3. AR Trigger Window will show where the “triggers” occurred
4. Do you want to do an Automatic Revision? (Informational Only-will **NOT** do anything)
 - a) Select Yes, if you really thought you would do an AR with this revision trigger
 - b) Select No, if you would not do anything with this revision trigger

The screenshot displays the nCTOP v0.65 (Master) interface. The 'Automatic Revision (AR)' section is highlighted with an orange box and labeled '2'. It shows settings for 'Look-Ahead: 3 hrs', 'Offset: 1 hr', 'Refresh Interval: 15 min.', and 'Smoothing Factor: 15 min.'. The 'AR' checkbox is checked 'On'. Below this, the 'FCA Parameters' section shows a table of demand and capacity data for various time periods. The 'AR_Above' and 'AR_Below' values are set to 0 and 1 respectively, highlighted with an orange box and labeled '1'. A dialog box titled 'Automatic Revision was triggered for FCA "FR"!' is open, showing details of the trigger and asking 'Do you want to do an Automatic Revision?'. The 'Yes' button is highlighted with an orange box and labeled '4'. The 'Fill: AR_Above' dropdown is highlighted with an orange box and labeled '3'.

Model: CTOP-ALL

Parameters

Name: CTOP006 NASA134 Start: 0000 End: 0000 Purge Program

Rank: 1 Change... Automatic Revision (AR): ☒ Look-Ahead: 3 hrs Offset: 1 hr Refresh Interval: 15 min. Smoothing Factor: 15 min. ☐ AR Start: End:

Total Flights: 308

FEA/FCAs: FS, FW, FN, FR Exemptions: Apply Exemption

Exempt all flights departing within 45 minutes. Pop-Up Delay Limit (minutes): 180 Default

FCA Parameters

View: FR 15 60 Model Time: 1952

| Time: | 1945 | 2000 | 2015 | 2030 | 2045 | 2100 | 2115 | 2130 | 2145 | 2200 |
|-----------|------|------|------|------|------|------|------|------|------|------|
| Demand: | 0 | 6 | 10 | 11 | 10 | 11 | 12 | 11 | 10 | 12 |
| Capacity: | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| AR_Above: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AR_Below: | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Fill: AR_Above

Bar Chart

FR

Automatic Revision was triggered for FCA "FR"!

An Automatic Revision was triggered in 3 place(s).

ABOVE [2115] Diff: 1.0 (SF: 1 bins, Bin Amts: 1, Bin Avg: 1.0, AR Avg: 0)

ABOVE [2200] Diff: 1.0 (SF: 1 bins, Bin Amts: 1, Bin Avg: 1.0, AR Avg: 0)

ABOVE [2230] Diff: 1.0 (SF: 1 bins, Bin Amts: 1, Bin Avg: 1.0, AR Avg: 0)

Do you want to do an Automatic Revision?

Yes No

nCTOP Note Section:



- **Note:** Brings up window to free type in
 - Please enter anything you feel we need to know
 - Example:
 - The flight list had buggy behavior
 - Give reason for AR “YES”
 - I would do XYZ right now if I was allowed
- **Functional Note Buttons: IFP, MS, AP**
 - IFP: Click this right before doing IFP on ERAM TSD
 - MS: Click this right before doing MS on ERAM TSD
 - AP: Click this right before doing AP on ERAM TSD
- These Buttons help us with our data analysis to better understand what was happening at the time.

Please use them for anything you want to tell us!

nCTOP v0.67 (Master) [idm rta]

Model: CTOP-ALL

Parameters

Name: CTOP009 NASA134 Start: 0000 End: 0000 Purge Program

Rank: 1 Change... Automatic Revision (AR):

Look-Ahead: 3 hrs Offset: 1 hr Refresh Interval: 30 min.

AR Start: End: Smoothing Factor: 45 min.

On Off

FEA/FCAs: FS, FW, FN, FR Draw Add/Remove

Exemptions: Apply Exemption

Exempt all flights departing within 45 minutes.

Pop-Up Delay Limit (minutes): 180 Default

FCA Parameters

View: FR 15 60 Model Time: 2201

| Time: | 2200 | 2215 | 2230 | 2245 | 2300 | 2315 | 2330 | 2345 | 0000 | 0015 |
|-----------|------|------|------|------|------|------|------|------|------|------|
| Demand: | 0 | 0 | 0 | 0 | 5 | 11 | 10 | 12 | 16 | 16 |
| Capacity: | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| AR_Above: | | | | | | | | | | |
| AR_Below: | | | | | | | | | | |

Fill: Capacity With: From: 2200 Through: 2215 Fill Fill All Reset

FEA/FCA: Start: 2200 End: 0300 Ceiling: 600 Floor: 0 Edit...

Bar Chart

FR Hours Visible: 8 15 30 60 Capacity AR Merge flows

ALL Routed Out All Other NC Demand CTD Exempt Other

Flight List

FR (COUNT: 194)

| # | FCA | ACID | BETD | CTD | Ground Delay | ETA | STA | Sch. Delay | Current RTE | ORIG | DSC Item II |
|-----|-----|---------|------|------|--------------|------|------|------------|----------------------------|------|-------------|
| 001 | FR | JBU6 | - | - | 2303 | 2303 | 0 | 0 | KFLL..NUTAL197054..N... | KFLL | ZBW_01 |
| 002 | FR | ASQ4276 | 2215 | 2215 | 0 | 2305 | 2306 | 0 | KGSO../SBV../CREME.J51... | KGSO | ZBW_01 |
| 003 | FR | N467SH | 2204 | 2204 | 0 | 2311 | 2311 | 0 | KLEX../MOL../GVE.PHLBO... | KLEX | ZBW_01 |
| 004 | FR | SKV7007 | 2232 | 2232 | 0 | 2312 | 2312 | 0 | CYYZ../AIRC../GEE.FLO... | CYYZ | ZBW_01 |
| 005 | FR | ASQ4672 | 2202 | 2202 | 0 | 2313 | 2313 | 0 | KCHS../GINNE../FLO.J55... | KCHS | ZBW_01 |
| 006 | FR | ASQ4352 | 2202 | 2202 | 0 | 2315 | 2315 | 0 | KCVG../DIRKE../DJB.J29... | KCVG | ZOB_01 |
| 007 | FR | UAL1116 | 2244 | 2244 | 0 | 2315 | 2316 | 0 | KBOS../PATSS../NELIE.F... | KBOS | ZBW_01 |
| 008 | FR | UAL237 | 2215 | 2215 | 0 | 2318 | 2318 | 0 | KMYR../FAK.PHLBO3.KEWR | KMYR | ZBW_01 |
| 009 | FR | RPA4898 | 2242 | 2242 | 0 | 2317 | 2320 | 0 | KIAD../FABER../GEEMO.... | KIAD | ZBW_01 |
| 010 | FR | UPS1082 | 2203 | 2203 | 0 | 2321 | 2321 | 0 | KSDF../COLMU../DORET.... | KSDF | ZOB_01 |
| 011 | FR | JBU328 | - | - | 2321 | 2322 | 0 | 0 | KMCO../SSI098044../PAI... | KMCO | ZBW_01 |
| 012 | FR | N468PU | 2220 | 2220 | 0 | 2324 | 2324 | 0 | KGRR../CODIB../ERI..TD... | KGRR | ZOB_01 |
| 013 | FR | UAL1262 | 2203 | 2203 | 0 | 2326 | 2326 | 0 | KORD../DUFEE../ELX../HA... | KORD | ZOB_01 |
| 014 | FR | UCA4775 | 2257 | 2257 | 0 | 2324 | 2327 | 0 | KBWI../SWANN.RUUTH1.KEWR | KBWI | ZBW_01 |
| 015 | FR | UAL943 | - | - | 2328 | 2328 | 0 | 0 | EGLL../YYG010026../ZON... | EGLL | ZBW_01 |
| 016 | FR | TCF3556 | 2216 | 2216 | 0 | 2330 | 2330 | 0 | KIND../BDOCK../SERIE.... | KIND | ZOB_01 |
| 017 | FR | AAL320 | - | - | 2329 | 2332 | 0 | 0 | KDFW../GHM094010../TKX... | KDFW | ZBW_01 |
| 018 | FR | SWA45 | - | - | 2332 | 2333 | 0 | 0 | KHOU../BNA246004../HAR... | KHOU | ZBW_01 |
| 019 | FR | UCAS177 | 2314 | 2314 | 0 | 2334 | 2334 | 0 | KBDL../NELIE.FLOS13.KEWR | KBDL | ZBW_01 |
| 020 | FR | ASQ4301 | 2209 | 2209 | 0 | 2337 | 2337 | 0 | KMKE../SQUIB../MKG../EC... | KMKE | ZBW_01 |
| 021 | FR | UAL1492 | 2215 | 2215 | 0 | 2337 | 2337 | 0 | KORD../DUFEE../ELX../HA... | KORD | ZOB_01 |

Filter: From: Through: Customize Columns... Advanced Sort... Refresh ETD

Show Current Route Show Assigned Route

Flight Search Flight Info Flight History

Model Send Proposed Send Actual Reset Cancel

note IFP MS AP

Other Important Stuff to Know

- **Departure Error**

- Conformance error
 - +/- 5 min External
 - +2/-1 min Internal
- Non-Conformance Error
 - +/- 20 min External
 - +/- 4 min Internal
- Really out of Conformance (1 each External/Internal)
 - External
 - Outside Call to nCTOP Planner need 30 minute delay due to mechanical
 - Internal
 - Outside Call to XM Planner need 30 minute delay due to mechanical

- **Automatic Revision (AR)**

- TFMS can set-up AR, but informational only
- When trigger box appears, look at information
 - Hit Yes if you would have done an AR at that time
 - No action will happen, just data point
 - Hit No if you would not have done an AR at that time



rTA Options

- **rTA Planner (command center) Coordinates rTA (CR) to controller, controller uplinks or voices to pilot**
- **Airline Ops Center ATC Coordinator uplinks rTA (UR) to pilot; pilot notifies ATC of speed change to meet time of arrival**

First RTA Option: Issue RTAs to FCA Arcs: Fix @ xx:xx:xx

RTA Planner (via command center) sends to controllers

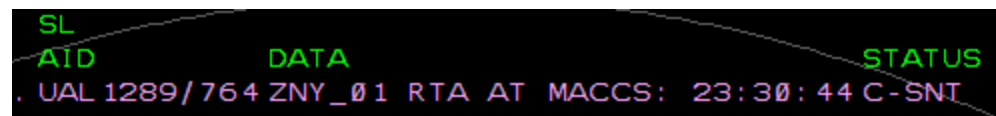
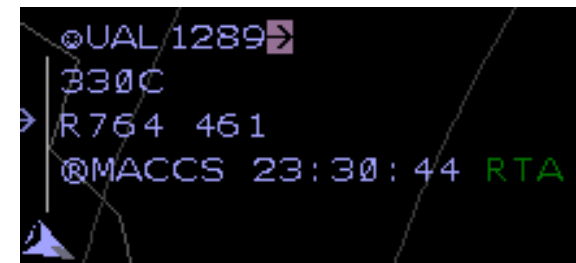
- After nCTOP FCA is fully implemented and EDCTs sent,
- Find RTA Eligible Flights on each flow

- Flying at Cruise Altitude
- ~600+ miles from EWR
- R in Flight Data Block
- @Symbol in Timeline



- Coordinate RTA (CR CID) to controller with track control

- Arrow portal in FDB will have pink box
- RTA information will be displayed in 4th Line of FDB
- FDB will minimize to just show RTA conformance color
- Data link message will appear in data link Status List
- When controller accepts and issues it to pilot the Message will WILCO and drop



Issue RTAs to FCA Arcs: Fix @ xx:xx:xx

RTA Planner (via command center) sends to controllers Controller to Pilot Actions

- Controllers will Uplink RTA to Flight Deck (UR CID /OK)
 - Controllers will voice up RTA to small number of aircraft (AAL, UAL, DAL)
 - Walk through the process (with/without data link)
 - Controllers will accept the CR message back to RTA Planner if pilot is able
 - Pilot will call controller if they are unable (+/- 1 min)
 - If +/- 2-4 minutes it is ok to let go (TBFM can handle it)
 - Over +/- 5 min.... Discuss protocol
 - Controller can reply unable to RTA Planner (or call to coordinate)
 - Then what?
 - RTA Planner adjusts time and then re-issues it?
 - Departure error is the biggest reason they would not be able to make it.....
 - Based on how far off they just let it go?
 - Mixed Equipage?

Second RTA Option: Issue RTAs to FCA Outer Arcs: Fix @ xx:xx:xx

Airline Operations Center (AOC) sends RTA to pilot

- After nCTOP FCA is fully implemented, Command Center will inform AOC
- Find RTA Eligible Flights on each flow

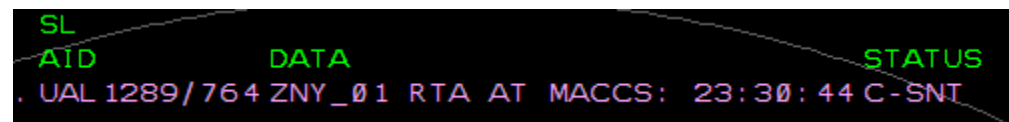
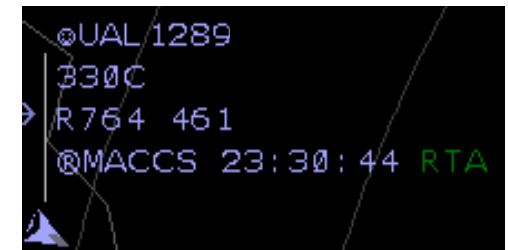
- Flying at Cruise Altitude
- ~600+ miles from EWR
- R in Flight Data Block
- @Symbol in Timeline



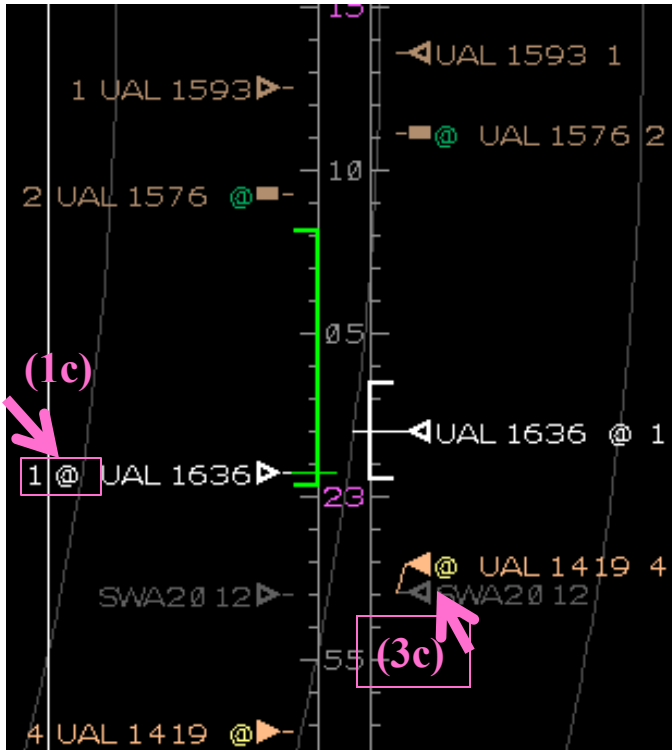
- Uplink RTA (UR /OK CID) to pilot directly



- RTA information will be displayed in 4th Line of FDB
- FDB will minimize to just show RTA conformance color
- Data link message will appear in data link Status List
- When pilot accepts Message will WILCO and drop
- Pilot will send unable message and/or call AOC if they are +/- 1 min unable



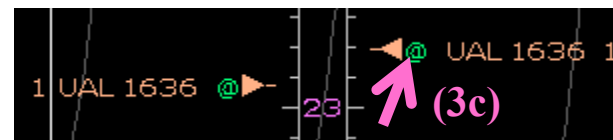
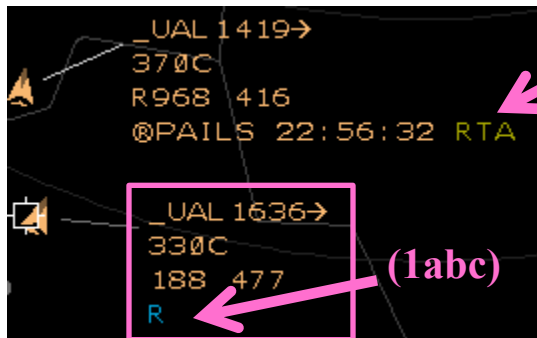
Issue RTAs to outer FCA Timeline Displays



@ Outside ACID means it is RTA Eligible
RTA Sent Conformance Good @
RTA Sent Conformance Close (+/- 60 sec.) @
RTA Sent Conformance Possibly Unable @

➤ Look at outer FCA Flow based timelines to send RTAs

1. Find RTA eligible Flights
 - a) Flying at Cruise Altitude
 - b) ~600+ miles from EWR
 - c) @ symbol outside ACID in Timeline or cyan **R** in FDB
2. Easy way to find and Center ACID on Timeline
 - a) Type **CT** or Pick on CT Macro
 - b) Middle click AC target symbol (Chevron) or [CID]
 - c) Timeline will center at ACIDs STA
3. Uplink RTA to flight deck (will freeze AC on TL)
 - a) Type **UR /OK** or Pick on UR Macro
 - b) Middle click on AC Target or ACID in TL
-Multiple AC on same flow (**UR CID CID /OK**)
 - c) @ RTA symbol will move inside ACID and color code to match conformance
 - d) RTA fix and time will show in full FDB
 - e) FDB will minimize with "RTA" conformance color



(2a) ➡

(3a) ➡

CT

UR

CT [CID] = Center ACID in TL at STA

UR [CID] = Uplink RTA clearance

If RTA is UNABLE

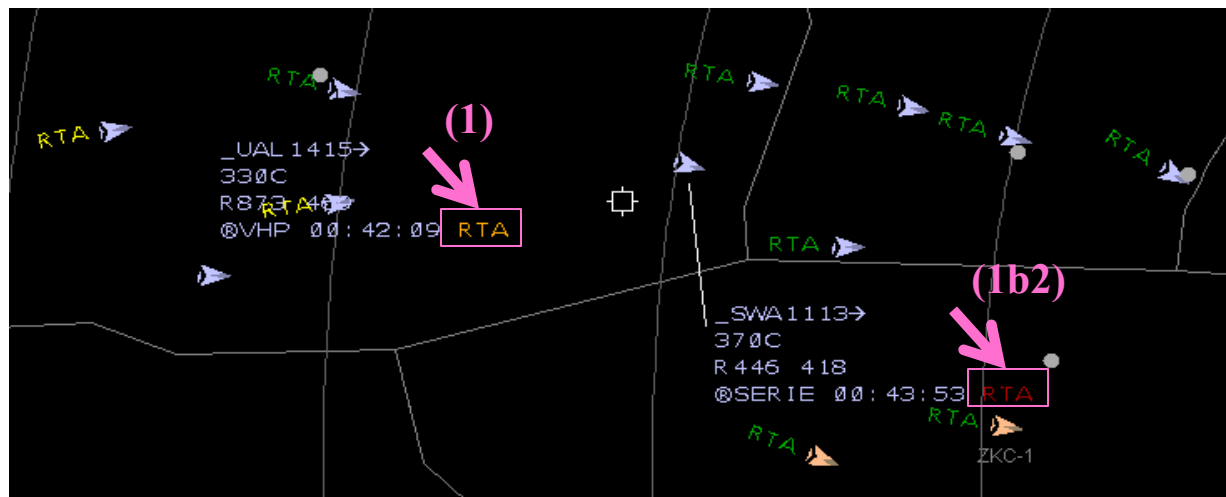
1. Respond to any “unable” calls from Pilot

- Pilot will call if he is unable to make the RTA within +/- 60seconds
- Turn **Orange** FDB RTA status **Red** (Flag unable) (FL)

- Type **FL [ACID]** or [CID] or [Middle Click on AC target] or [Middle Click on ACID in TL]

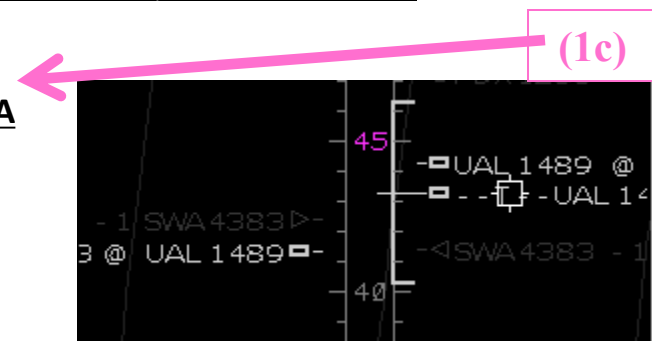
- 2. Orange** RTA will turn **Red** RTA Sas a flag

- If pilot can't make RTA OR, a departure error makes plane unable to do RTA you will need to manually reschedule and send new RTA. Only do this if it is reasonable for the schedule.



If needed, Manual Freeze AC in Timeline- Send new RTA

- Pick (Left click) on ACID STA side (turns white)
- Drag if needed to move up or back
- Preview Area will pre fill with AS FW 19:43:16 UAL 1489
- Type /OK hit [ENTER] (Symbol will become solid)
- Uplink (UR) new RTA to AC



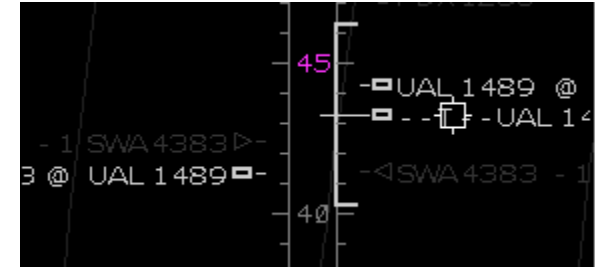
nCTOP Planner Shortcuts

- **nCTOP Planner Position (Macros are available on ERAM Display)**
 - **IFP <scheduler> /OK** In-flight Preference (Exempting in-flights before inacting nCTOP)
 - **MS <scheduler> /OK** Move Slot to close any gaps on FR only (after sending actual)
 - **MIS <scheduler> 1 /OK** Move Slot to close any gaps on 2 or 3 ARCs only (after sending actual)
 - Can type 1 or 2 after command to allow frozen inflights to be moved ahead of ETA 1 or 2 min.
 - **AP <scheduler> ALL /OK** Sends new Slot departure (p-times) to **ALL** pre-departures
 - **CT [CID]** Center Aircraft on Timeline
 - **QU [CID]** Shows Graphical Route of Flight (PICK (left click) on ACID in FDB)
 - **QF [CID]** Shows Flight Plan in Response Area (ENTER (middle click) on ACID in FDB)
- **Other AP Commands available if needed (Ask Researcher before attempting)**
 - **AP <scheduler> <ac> /OK** for single unfrozen pre-departure AC only
 - **AP <scheduler> ALL /OK** for all unfrozen pre-departure AC on the schedule
 - **AP <scheduler> <time> ALL /OK** only unfrozen pre-departure AC after given time
 - **AP <scheduler> <first-time> <second-time> ALL /OK** only AC between first and second time
 - **If Frozen then,**
 - **AP <scheduler> BOTH <ac> /OK** for single frozen pre-departure AC only
 - **AP <scheduler> BOTH ALL /OK** for both frozen and unfrozen pre-departure AC on the schedule
 - **AP <scheduler> BOTH <time> ALL /OK** both frozen and unfrozen **AC** after given time
 - **AP <scheduler> BOTH <first-time> <second-time> ALL /OK** only **AC** between first and second time
 - Note: BOTH indicates that both frozen and unfrozen predepartures will be processed. Otherwise, only unfrozen pre-departures are processed.

nCTOP Planner Keyboard Shortcuts

If needed, Manual Freeze AC in Timeline- Send new AP or SWAP

- Pick (Left click) on ACID STA side (turns white)
- Drag if needed to move up or back
- Preview Area will pre fill with AS FW 19:43:16 UAL 1489
- Type /OK hit [ENTER] (Symbol will become solid)
- Uplink (UR) new RTA to AC



ZZZZ Cleans up ALL extra FDBs and route lines



Find Fix (or airport): FX

- Find FIX on DSR (example)
 - Type FX [MCI] or
 - Type FX [KANSAS CITY]
- Fix will be highlighted on DSR
- 3 Letter ID and Full name will appear in CRD

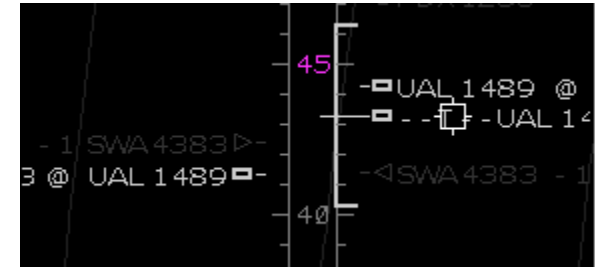
RTA Planner & AOC Shortcuts

- **RTA Planner Position Coordinates to controller with track control**
 - QU [CID] Shows Graphical Route of Flight (PICK (left click) on ACID in FDB)
 - QF [CID] Shows Flight Plan in Response Area (ENTER (middle click) on ACID in FDB)
 - CT [CID] Center Aircraft on Timeline
 - CR [CID] Coordinates RTA for FCA Arc to controller (will automatically freeze AC)
- **AOC RTA Position Uplinks directly to aircraft**
 - QU [CID] Shows Graphical Route of Flight (PICK (left click) on ACID in FDB)
 - QF [CID] Shows Flight Plan in Response Area (ENTER (middle click) on ACID in FDB)
 - CT [CID] Center Aircraft on Timeline
 - UR /OK [CID] Uplinks RTA for FCA Arc to Flight Deck (will automatically freeze AC)
 - UR /OK [CID CID CID] Uplink multiple RTAs to single flow
- **Other AP Commands available if needed (Ask Researcher before attempting)**
 - *If AC Frozen then,*
 - **AP <scheduler> BOTH <ac> /OK** for single frozen pre-departure AC only
 - **AP <scheduler> BOTH ALL /OK** for both frozen and unfrozen pre-departure AC on *schedule*
 - **AP <scheduler> BOTH <time> ALL /OK** both frozen and unfrozen AC after given time
 - **AP <scheduler> BOTH <first-time> <second-time> ALL /OK** only AC between first and second time

RTA Planner & AOC Shortcuts

If needed, Manual Freeze AC in Timeline- Send new RTA

- Pick (Left click) on ACID STA side (turns white)
- Drag if needed to move up or back
- Preview Area will pre fill with AS FW 19:43:16 UAL 1489
- Type /OK hit [ENTER] (Symbol will become solid)
- Uplink (UR) new RTA to AC



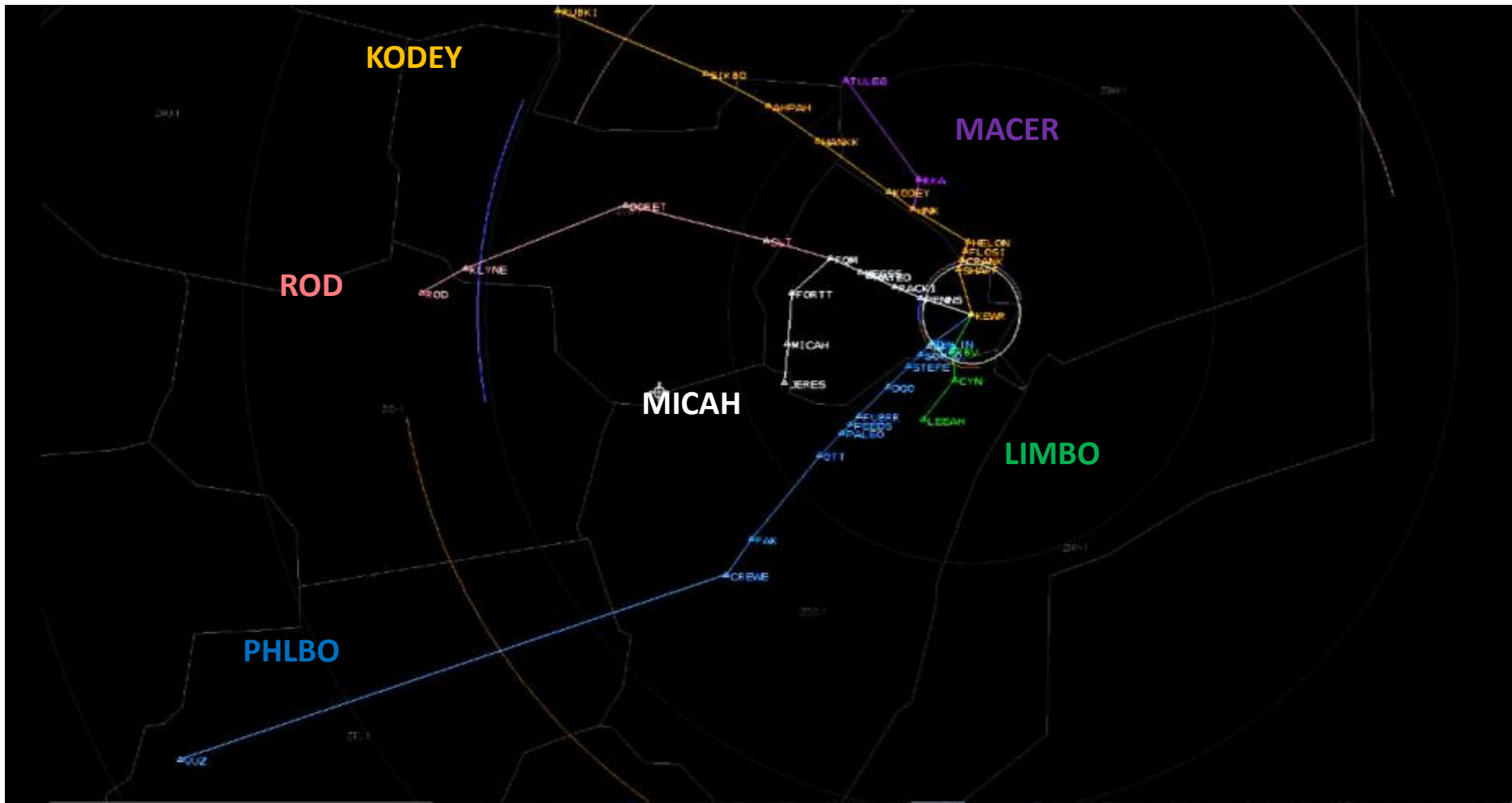
ZZZZ Cleans up ALL extra FDBs and route lines



Find Fix (or airport): FX

- Find FIX on DSR (example)
 - Type FX [MCI] or
 - Type FX [KANSAS CITY]
- Fix will be highlighted on DSR
- 3 Letter ID and Full name will appear in CRD

- Limited version of TOS options to explore concept
- External inflight or pre-departure re-routes
- Internal re-routes for pre-departure only





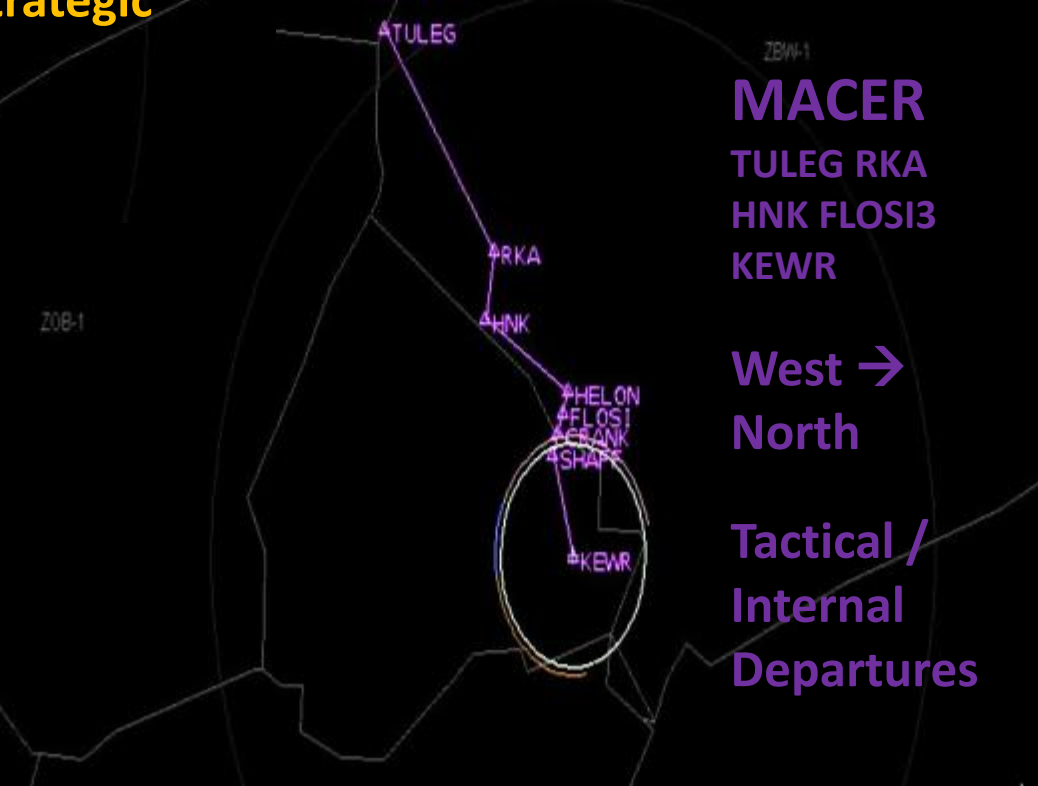
A map showing a flight path from SIKBO in the northwest to KEWR in the southeast. The path is marked with yellow labels: SIKBO, AHPAH, HANKK, KODEY HNK, FLOSI3, and KEWR. A yellow line connects these points. A blue oval encircles the area around KEWR, which also contains labels for PHELO, AFLOSI, CRANK, and SHAP. The map includes a compass rose in the bottom left and a label ZOB-1 on the left side.

KODEY
RUBKI SIKBO
AHPAH
HANKK
KODEY HNK
FLOSI3 KEWR

West →
North

Strategic

West Flow to North Flow

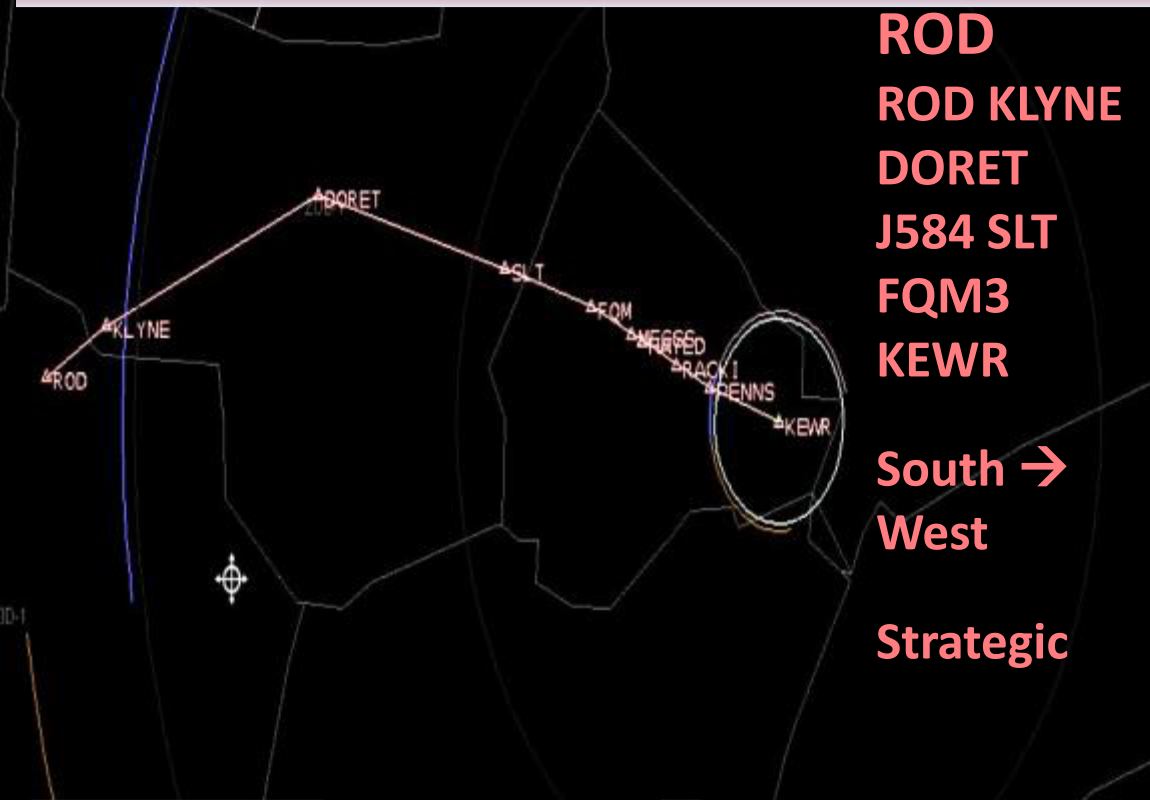


A map showing a flight path from TULEG in the northwest to KEWR in the southeast. The path is marked with purple labels: TULEG, ARKA, HNK, PHELO, AFLOSI, CRANK, SHAP, and KEWR. A purple line connects these points. A blue oval encircles the area around KEWR, which also contains labels for PHELO, AFLOSI, CRANK, and SHAP. The map includes a compass rose in the bottom left and a label ZOB-1 on the left side.

MACER
TULEG RKA
HNK FLOSI3
KEWR

West →
North

Tactical /
Internal
Departures

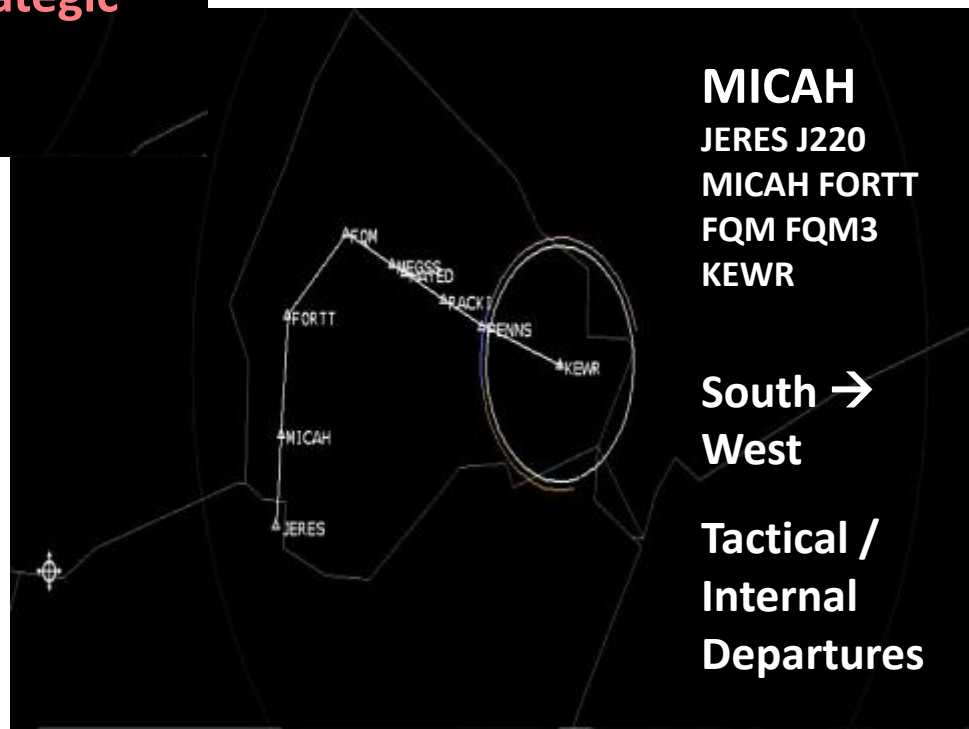


ROD
ROD KLYNE
DORET
J584 SLT
FQM3
KEWR

**South →
West**

Strategic

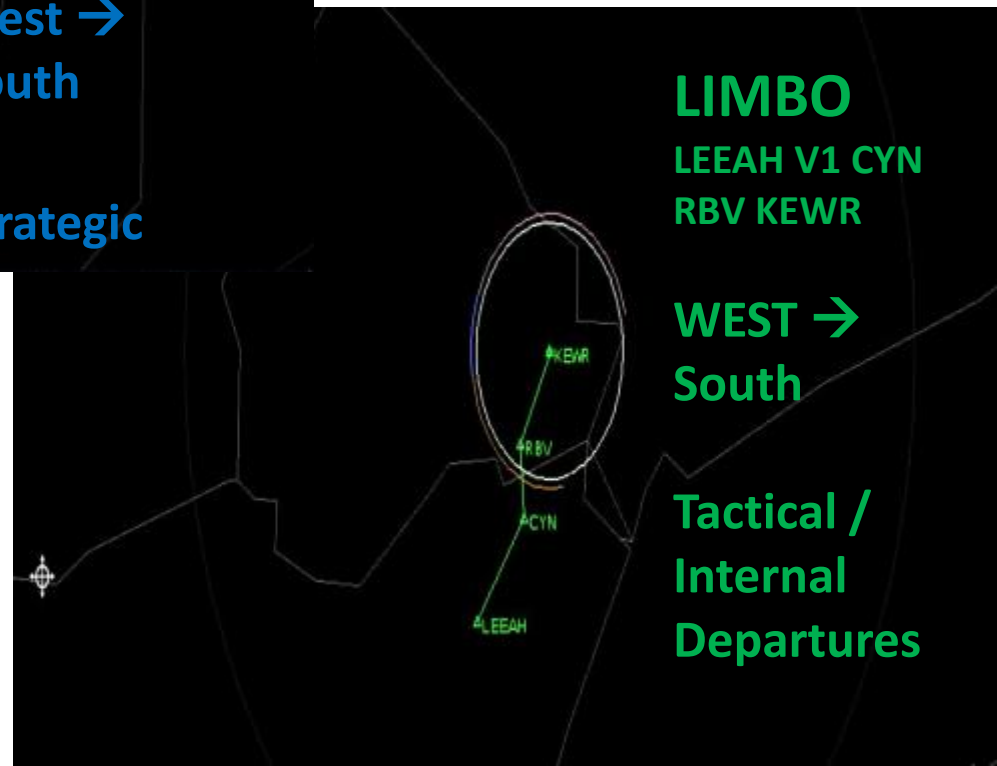
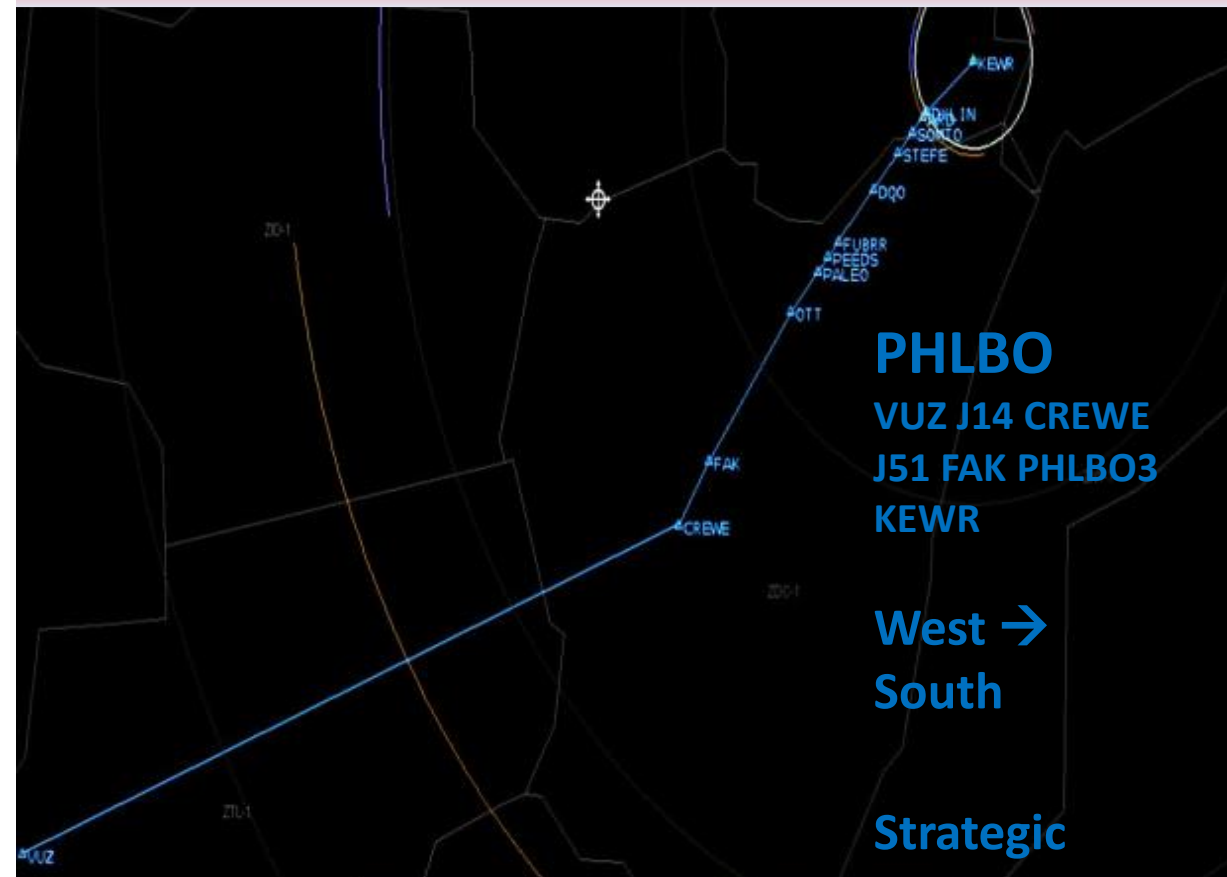
South Flow to West Flow



MICAH
JERES J220
MICAH FORTT
FQM FQM3
KEWR

**South →
West**

**Tactical /
Internal
Departures**



West Flow to South Flow



Communications & Coordination

TFMS Conditional Procedure- Rate Drop

- nCTOP Planner Position:

- Access Traffic Demand at FR and set-FR FCA to 36 rate
- Enter 9 for capacity value and fill all
- Model to see what should happen to traffic

- On ERAM TSD FR Scheduler:

- Pre-departures within 30 minutes from departure are exempt (automatically frozen on TL)
- Give in-flight aircraft preference: Type, IFP FR /OK (All inflight AC STAs will get as close to ETA as possible and freeze, only pushing pre-departures with more than 30 min from departure).

- nCTOP:

- Now need to send the modelled capacity changes to FR FCA scheduler: Hit SEND ACTUAL (prompt will ask if you are sure, hit YES)

- ERAM TSD FR Scheduler:

- You will see the scheduler spacing go from previous 11/15 min bin to 9/15 min bin.
- **IMPORTANT:** Move any gaps in slots that may have occurred to AC outside TBFM area: Type, MS FR /OK then *Middle click on ACID that is stable outside of TBFM time in timeline to start from (Make sure researcher is with you to help)..This action done wrong can cause lots of problems!!!*
- Send new Slot departure times (amend p-times): Type, AP FR ALL /OK (will send new p-times to all unfrozen pre-departures that have been moved, matching their ETA with the newly assigned STA).
- **Call TBFM and tell them the rate drop has been executed.**
- RTA condition only, Sends new RTAs as needed Type, **RU <scheduler> /OK** for each flow
- Baseline condition just monitor and be ready (TBFM will try to handle internally as done today)



EXTRA SLIDES IF NEEDED



ERAM for MACS

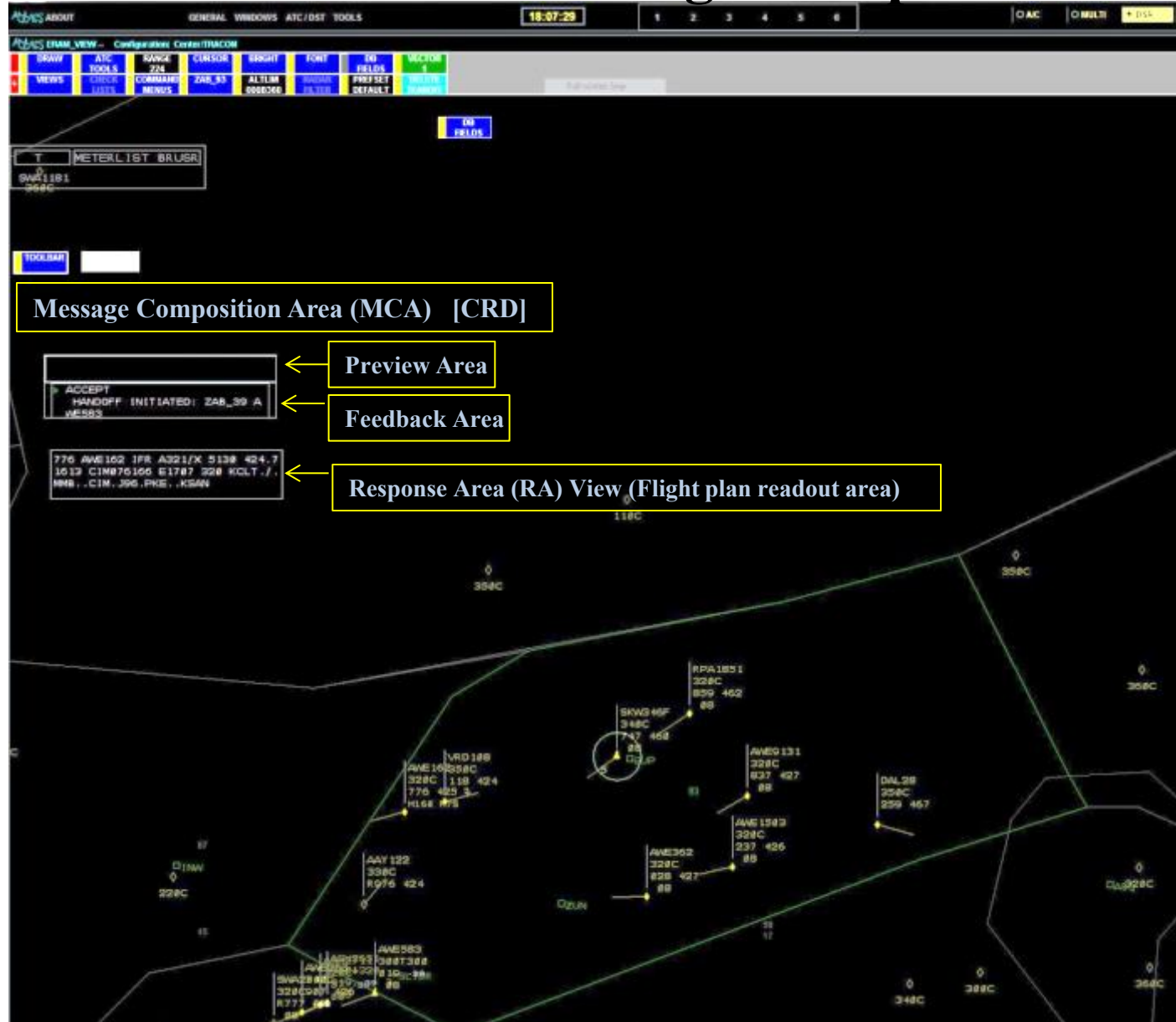
Training Guide

MACS ERAM Training Guide

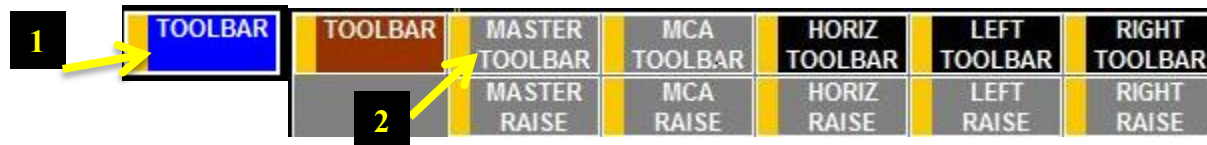
- Message Composition Area (MCA) [DSR CRD]
 - Preview Area
 - Feedback Area
- Response Area (RA) View (Flight plan readout area)
- MASTER TOOLBARS
 - TEAROFF Menu Items
 - Recordable Macros
 - Save PREFSET DEFAULT
 - DRAW Tools
 - ATC TOOLS
 - RANGE
 - VECTOR
 - CURSOR
 - BRIGHT
 - FONT
 - DB FIELDS
 - VIEWS
 - CRR (Continuous Range Readout), CFR (Continuous Flight Plan Readout) , MRP (Meter List)
 - COMMAND MENUS
 - Sector View (ex: ZAB_93)
- ERAM Flight Data Blocks
 - FIM FDB
 - FIM Meter List

NY TBO Tool Set

ERAM for MACS: Message Composition Area



ERAM for MACS: TOOLBAR- MASTER & MCA



1. Pick on TOOLBAR to open and position all Toolbar options
2. Pick on MASTER TOOLBAR to open most menu options
3. Menu options are detachable and can be placed on scope

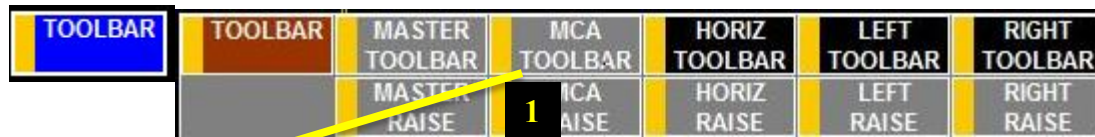
ERAM for MACS: Tool Bars-TEAROFF Menu options



TEAROFF menu items you can drag to scope

1. Open MASTER TOOLBAR
2. Pick on Yellow portion of the Menu
3. Drag it to the position you want on scope (you will see blank box) and pick again to drop
 - Then you can minimize TOOLBARs you don't need and only keep what you want
4. To Delete TEAROFF, Pick on DELETE TEAROFF button and then ENTER on menu you want to delete

ERAM for MACS: MCA TOOLBAR: Record Macros



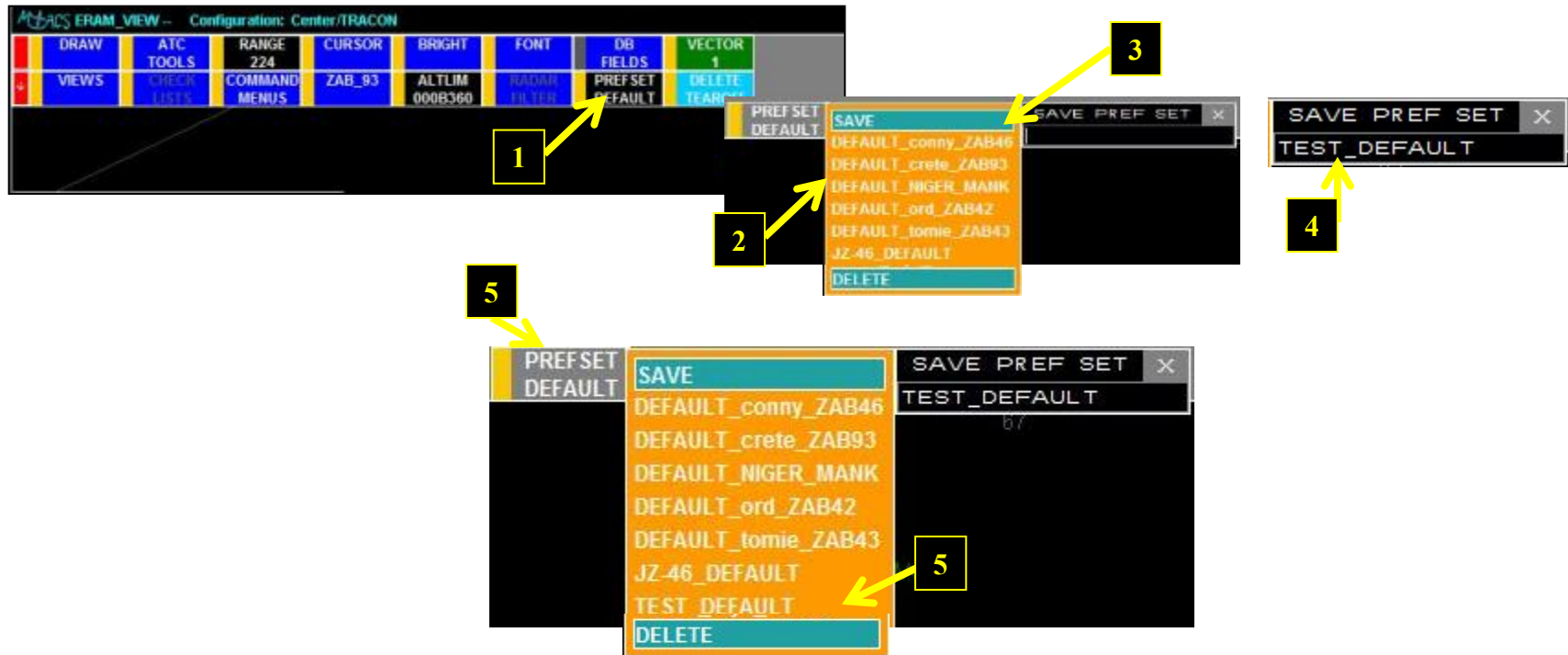
MACROS:

Create your own personalized TEAROFF menu items you can drag to toolbar or scope

1. Pick on MCA TOOLBAR, toolbar with RECORD button appears
2. Pick Record Button
3. Pick Message button and type in command you want saved: i.e., QU GUP.EAGUL5.ILS26 or 93
4. Pick SAVE MSG, then name it as you wish {93}, hit ENTER (macro will now be moveable)
5. Move Macro to Master Tool Bar Area or onto scope (you will see blank box again).
6. To save MACROS (and all other settings) for future use, Pick on PREF SET DEFAULT on MASTER TOOLBAR
 - Select PREF SET DEFAULT (See Next Slide)



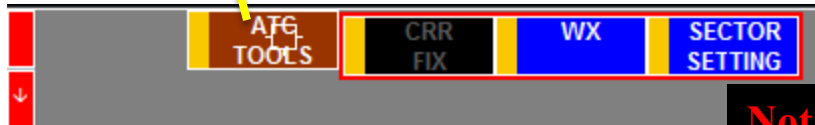
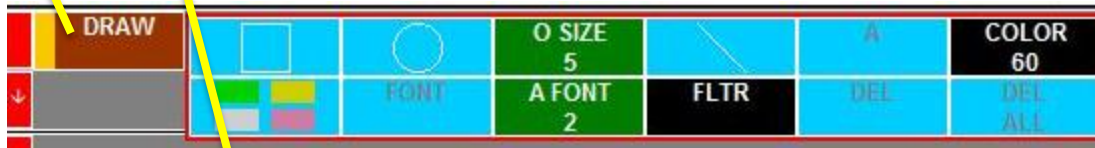
ERAM for MACS: MCA TOOLBAR: Save PREFSET DEFAULT



To save MACROS (and all other settings)for future use:

- 1. Pick on PREFSET DEFAULT on MASTER TOOLBAR**
- 2. PREFSET DEFAULT Menu Drops Down**
- 3. Pick on SAVE Button (Save PREF SET Box Appears)**
- 4. Type in Name [TEST_DEFAULT], hit ENTER**
 - **Personalize: SISO and Sector # and East/West flow: CB_93West**
- 5. Pick on SAVE PREFSET, TEST_DEFAULT (or whatever you name it) will appear in Drop down list**

ERAM for MACS: TOOLBAR-DRAW, ATC TOOLS, RANGE



Not really applicable-no weather non functioning

ERAM for MACS: Tool Bars-Range Selection



Pick, then Drag to desired range or type in desired range

ERAM for MACS: Tool Bars-CURSOR, BRIGHT, FONT, DB FIELDS

MACS ERAM_VIEW -- Configuration: Center/TRACON

| | | | | | | | |
|---------|-------------|---------------|---------|----------------|--------------|-----------------|----------------|
| DRAW | ATC TOOLS | RANGE 224 | CURSOR | BRIGHT | FONT | DB FIELDS | VECTOR 1 |
| ↓ VIEWS | CHECK LISTS | COMMAND MENUS | ZAB 193 | ALTLIM 000B360 | RADAR FILTER | PREFSET DEFAULT | DELETE TEAROFF |

Home Key: VECTOR lines PICK/ENTER (inc/dec) value

Details on the HOME-VECTOR button

- HOME button moves cursor to the VECTOR.
- If you release the HOME button the cursor stays there and you are free to PICK/ENTER to increase or decrease the vector value.
- But if you continue to hold the HOME down, then each pressing of the ENTER cycles the cursor through VECTOR, RANGE VIEW, and display center.

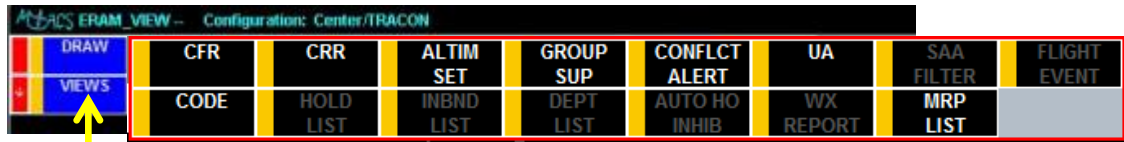
| | | | |
|--------|---------|--------|----------|
| CURSOR | SPEED 2 | SIZE 4 | VECTOR 1 |
|--------|---------|--------|----------|

| | | | | | | | | | |
|--------|------------|------------|------------|----------|----------|----------|-----------|-----------|-------------|
| BRIGHT | MAP BRIGHT | TARGET 85 | HIST 100 | FDB 100 | LDB 85 | WX 50 | LINE 4 10 | DWELL 75 | CURSOR 100 |
| | BCKLGHT 95 | BUTTON 100 | BORDER 100 | TEXT 100 | TEXT 100 | TEXT 100 | TEXT 100 | BCKGRD 50 | TOOLBAR 100 |

| | | | |
|------|----------|-------|-----------|
| FONT | LINE 4 = | FDB 3 | TOOLBAR 1 |
| | RDB 1 | LDB 3 | OUTAGE 1 |

| | | | | | | |
|-----------|-------------|-------------|---------|-----------|-------------|-----------|
| DB FIELDS | NON-RVSM | DEST | TYPE | FDB LDR 1 | B CAST FLID | NON-ADS-B |
| | NONADSB 100 | TFM REROUTE | CRR RDB | STA RDB | DELAY RDB | TMA COLOR |

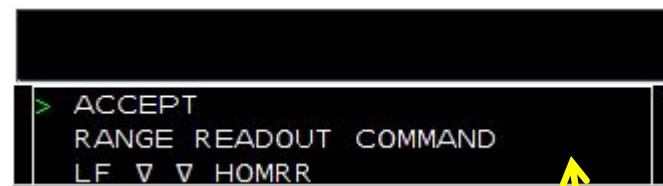
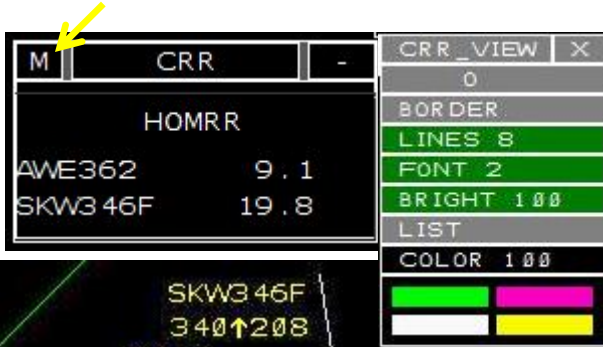
ERAM for MACS: Tool Bars- VIEWS (CFR & CRR)



Continuous Flight Plan Readout (CFR):

- QF CID to add Flight Plan to CFR

| M | CFR | | | | | | DEL ALL | SHOW FIELDS | - |
|------|---------|---------|------|-----|----------|-------|---------|-------------|--------------------------|
| FLID | TYP | BCN | SPD | FIX | TIM | ALT | RTE | | |
| A144 | SKW346F | CR J9/X | 3330 | 366 | PUMPS01. | E2016 | 340 | KDEN./ | ALS.J102.GUP.EAGUL5.KPHX |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

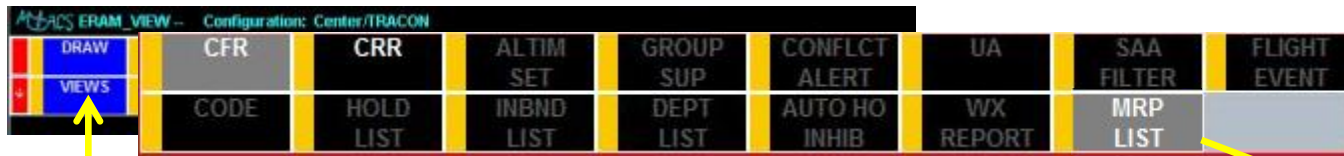


Continuous Range Readout (CRR):

- LF [Pick Point] *[name it]
- LF [pick] or type CID to add aircraft(s) [name]
- CRR Menu: pick on M, color menu appears
- Delete aircraft from list: pick on ACID delete button appears



ERAM for MACS: Tool Bars- VIEWS Cont. (MRP LIST)



Meter Reference Point (MRP):

- Pick Views
- Pick MRP LIST
- Pick on desired Meter Fix (GEELA)
- Place anywhere on scope
- Or, Type ML GEELA (toggles on/off)

| M | MRP | - |
|---|--------|---|
| | ZAB_39 | |
| | PHX26 | |
| | PHX25L | |
| | PRUNN | |
| | SCADE | |
| | TOMPY | |
| | L INEA | |
| | BRUSR | |
| | HOMRR | |
| | SQUEZ | |
| | GEELA | |

| | GEELA | |
|-----------|-------|--------|
| < SWA3600 | 1651 | -00:10 |
| < SWA1111 | 1645 | -00:30 |
| < SWA288 | 1644 | -00:10 |
| < ASH2816 | 1639 | -01:00 |
| < AWE511 | 1638 | +00:10 |
| AWE231 | 1634 | -00:10 |
| < SWA1043 | 1633 | +00:50 |

ERAM for MACS: Tool Bars-COMMAND MENUS

| | | | | | | | |
|------------|----------------|------------------|--------|-------------------|-----------------|--------------------|-------------------|
| DRAW | ATC TOOLS | RANGE 224 | CURSOR | BRIGHT | FONT | DB FIELDS | VECTOR 1 |
| ↓ VIEWS | CHECK LISTS | COMMAND MENUS | ZAB_93 | ALTLIM 000B360 | RADAR FILTER | PREFSET DEFAULT | DELETE TEAROFF |

Home Key: VECTOR lines
PICK/ENTER (inc/dec) value

Command Menu Appears with:

- PVD (QP)
- ALT (QZ)
- INT (QQ)
- RNG BRG
 - RANGE BEARING (LA)
 - RANGE/BEARING/FIX (LB)
 - CONTINUOUS RANGE READOUT (LF)

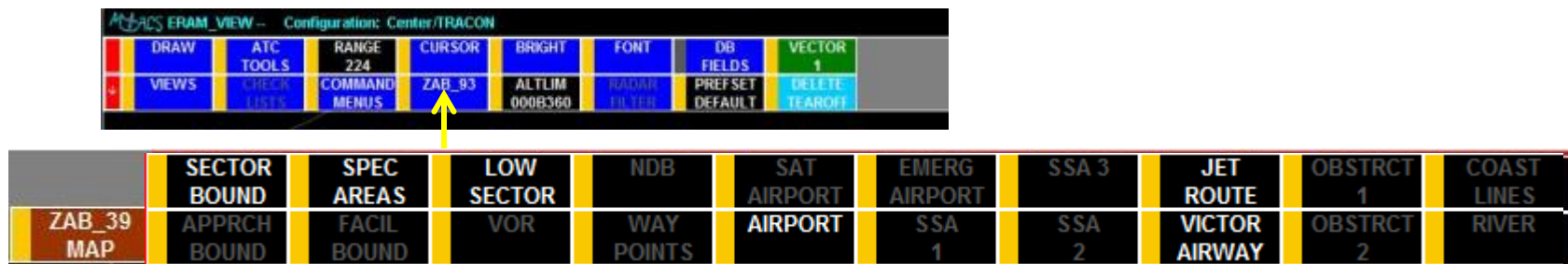
Keyboard KEYS mostly work

- FR (QF)
- RTE (QU)
- HALO (QP J)
- LOOK (QL)
- PVD (QP)
- ALT (QZ)
- INT (QQ) temp alt.
- QS speed 4th line FDB
- QS/ heading 4th line FDB
- QS/ [free wx symbol] Free Text

| | | | |
|------------------|-------------------|------------|----------------------|
| COMMAND MENUS | RNG BRG PVD | RSB ALT | INT METER LIST |
|------------------|-------------------|------------|----------------------|

| | |
|--------------------------|-----|
| RANGE BEARING | F1 |
| RANGE/BEARING/FIX | F3 |
| FIX/TIME | F5 |
| ROUTE FIX/TIME | F7 |
| ROUTE FIX TIME/SPEED ADJ | F9 |
| CONTINUOUS RANGE READOUT | F10 |

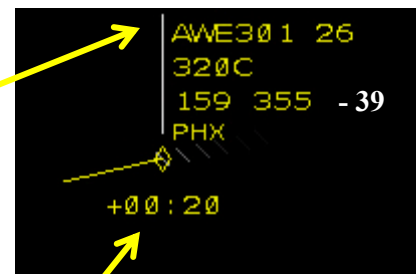
ERAM for MACS: Tool Bars- Sector View ZAB_93 (example)



ERAM for MACS: Interactive Flight Data Blocks

- Pick ACID to get route line display
- ENTER ACID to get flight plan readout display
- ALT Drop down Menu via Pick on ALT
- Heading Drop Down Menu via Pick on CID
- Speed Drop Down Menu via Pick on Speed
- Destination 4th Line (HDG and SPD)

- ❖ Target Symbol has DCT (Delay Countdown Timer)
- ❖ + time = Early (Slow or Vector to absorb delay)
- ❖ - time = Late (Seed-up or Short cut to catch up)



Multi-Aircraft Selection

- FF Keyboard Command for Multi-Selection Function [SEL] or [000] or [CID CID CID]
- 3 ways to enter the Multi-Select Method
 - FF Draw Box around aircraft symbols
 - FF Middle click on aircraft symbols (Chevron)
 - FF [CID CID CID] (type CIDs)
- FF ENTER clears all multi-selections

Multi-Aircraft Select Options

3 Multi-Aircraft Select Modes to begin:

1. Draw Box around Set

- Type FF in CRD and PICK and hold on DSR to make drag box around aircraft to be selected
- Release and FDBs will open and appear in highlighted boxes
- Must hit ENTER on keyboard to keep selection

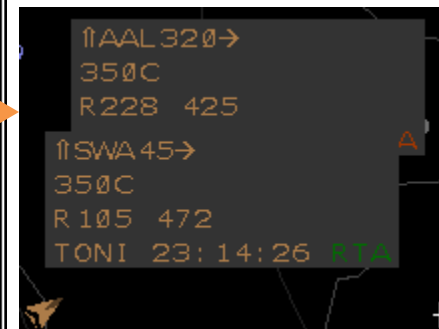
2. Or, Type FF and trackball Pick on aircraft symbols to add to selection, ENTER

3. Or, Type FF [CID CID CID] , ENTER

4. Uplink RTA to multiple aircraft at once

- After FF command, Type UR /OK or click on UR macro
- SEL or CIDs **UR /OK SEL**

- FF Enter again to remove multi selection



Pop-Up Delay Limit (minutes): 180

FCA Parameters

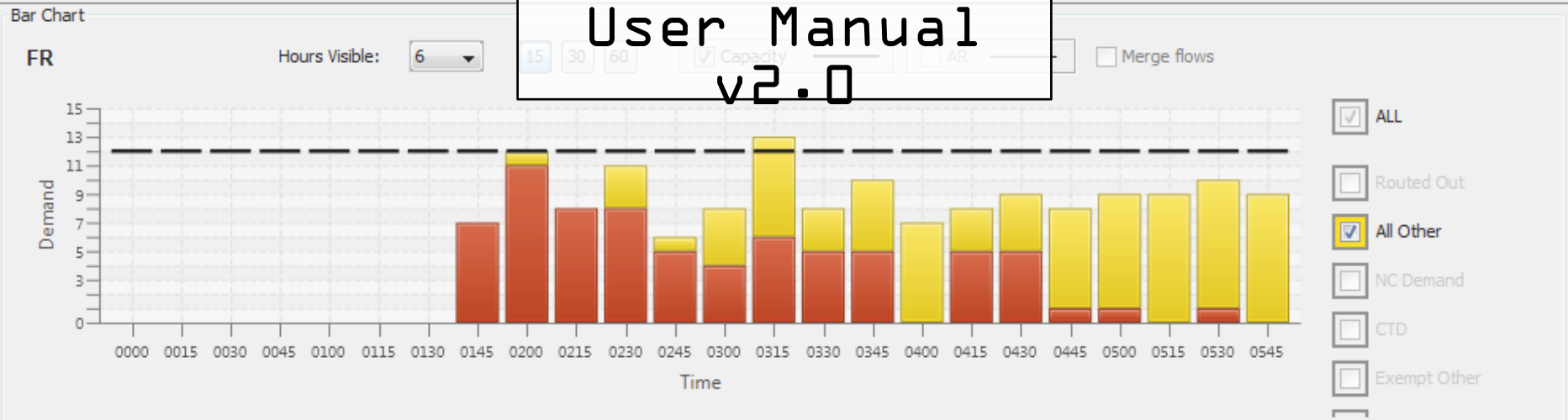
View: FR

| Time: | 0000 | 0015 | 0030 | 0045 | 0100 | 0115 | 0130 | 0145 | 0200 | 0215 | 0230 | 0245 |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|
| Demand: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 12 | 8 | 11 | 6 |
| Capacity: | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| AR_Above: | | | | | | | | | | | | |
| AR_Below: | | | | | | | | | | | | |

Fill: Capacity With: From: Through: Fill All Reset

FEA/FCA: Start: 0145 End: 0645

ncTOP
User Manual
v2.0



Flight List

FR (COUNT: 186)

| # | FCA | ACID | BETD | CTD | Ground Delay | ETA | STA | Sch. Delay | Current RTE | ORIG | DSC item ID |
|-----|-----|---------|------|------|--------------|------|------|------------|--|------|-------------|
| 076 | FR | N450HA | 0241 | 0241 | 0 | 0352 | 0352 | 0 | KLEX./..MOL../GVE.PHLB03.KEWR | KLEX | ZBW_01 |
| 077 | FR | N526AC | 0246 | 0246 | 0 | 0353 | 0353 | 0 | KGRR./..CODIB../ERI../TDT../SLT.FQM3.KEWR | KGRR | ZOB_01 |
| 078 | FR | TCF3789 | 0314 | 0314 | 0 | 0355 | 0355 | 0 | KPIT./..CETPU../EWC../PEREA../ZORBO../SLT.FQM3... | KPIT | ZOB_01 |
| 079 | FR | ASQ4204 | 0216 | 0216 | 0 | 0357 | 0357 | 0 | KJAX./..CAE.J51.FAK.PHLB03.KEWR | KJAX | ZBW_01 |
| 080 | FR | SKV7468 | 0316 | 0316 | 0 | 0358 | 0358 | 0 | CYYZ./..AIRCO../GEE.FLOSI3.KEWR | CYYZ | ZBW_01 |
| 081 | FR | DAL1942 | 0230 | 0230 | 0 | 0400 | 0400 | 0 | KATL./..JIRUL../CREWE.J51.FAK.PHLB03.KEWR | KATL | ZBW_01 |
| 082 | FR | ASQ4646 | 0245 | 0245 | 0 | 0402 | 0402 | 0 | KCHS./..GINNE../PAIS../TUBAS.J51.FLOPS../FAK... | KCHS | ZBW_01 |
| 083 | FR | UAL1626 | - | - | | 0357 | 0403 | 0 | KSAN./..FQF248073../JLI../TRM.J236.TBC.J128.... | KSAN | ZOB_01 |
| 084 | FR | ASQ4596 | 0223 | 0223 | 0 | 0405 | 0405 | 0 | KSTL./..SERIE../DORET../ZORBO.J584.SLT.FQM3.... | KSTL | ZOB_01 |
| 085 | FR | ASQ4528 | 0234 | 0234 | 0 | 0407 | 0407 | 0 | KMKE./..SQUIB../MKG../ECK../HAVOK../GEE.FLOSI3... | KMKE | ZBW_01 |
| 086 | FR | UAL1211 | - | - | | 0356 | 0408 | 0 | KSFO./..PUB098029../ICT../SGF../FAM../HARDU../G... | KSFO | ZBW_01 |

Purpose

This document is a technical description of the operation of the nCTOP research tool developed at NASA Ames Research Center which is used to emulate the FAA's CTOP tool. While there are important considerations with regard to the strategic use of CTOP and its role in the greater traffic management goals in the NAS, those discussions are outside the scope of this document. Here we will focus on the technical details of nCTOP: how it works and how to operate it.

Note: The nCTOP tool is for NASA research purposes only and it is not associated with the development or any planned future operation of the FAA's fielded CTOP tool in any way.

Contents:

- 1. Using nCTOP (participant)**
2. Setting up nCTOP (researcher)
3. Enhancing nCTOP (developer)

Overview

What is CTOP?

It refers to both a *traffic management initiative* (TMI) and a *tool* used to establish such an initiative. Effectively, it is a program that limits the quantity of aircraft flying over certain *flow-controlled areas* (FCAs) based on the amount the area can manage in 15-minute increments.

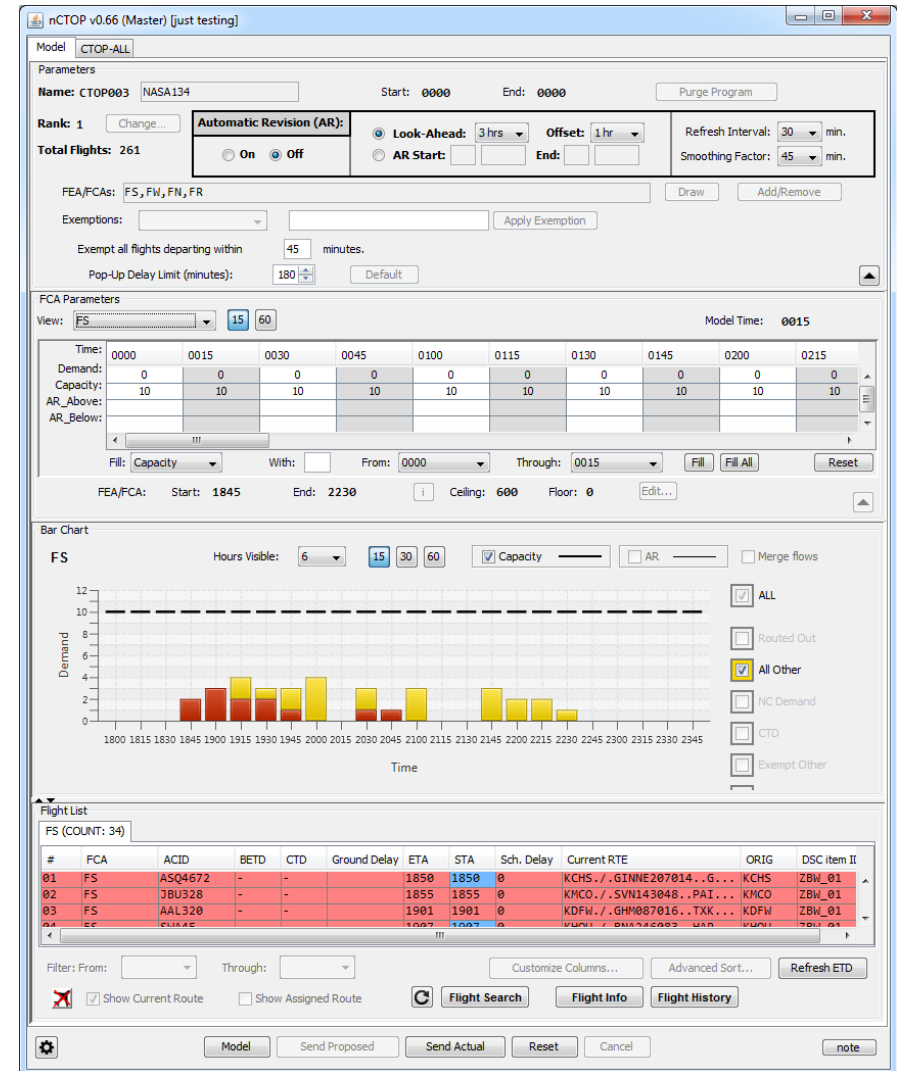
The remaining parts of this document will assume some basic working knowledge of how CTOP is supposed to work and will explain how *nCTOP* operates, which differs in some ways from the actual tool used by FAA.

Using nCTOP

Comparison



Actual CTOP application



nCTOP

Using nCTOP

Differences

Visually nCTOP looks similar to the real CTOP application, but there are key differences. Instead of trying to list all these upfront and confusing you with a list of things you haven't heard of I will point these out as I go through the slides.

All the colors in this document are generally just for matching features with their descriptions.

They have no inherent meaning except in cases where a feature is different from the real CTOP, in which case it will be **bold and purple**.

Using nCTOP

Parameters

nCTOP has many of the features of CTOP along with some additional ones, many of which can be toggled on or off as needed for experimental purposes.

First is the **Parameters** section. With nCTOP, the only part of this section that can be meaningfully interacted with is the **Automatic Revision** section.

No other items do anything, other than the **FEA/FCAs line** which displays the FCAs in use, and the **collapse button** which collapses the section to a smaller form.

The screenshot shows the nCTOP v0.67 (Master) [just testing] software interface. The interface is divided into several sections: Parameters, Demand, Bar Chart, and Flight List. The Parameters section at the top includes fields for Name (CTOP007), Start (0000), End (0000), Rank (1), and Total Flights (292). It also features a section for Automatic Revision (AR) with options for Look-Ahead (3 hrs), Offset (1 hr), and Refresh Interval (30 min). Below this is a section for FEA/FCAs with a line showing the current selection. The Demand section shows a table of demand data for various flights. The Bar Chart section displays a bar chart of demand over time. The Flight List section at the bottom shows a table of flight details, including flight number, FCA, ACID, BETD, CTD, Ground Delay, ETA, STA, Sch. Delay, Current RTE, ORIG, and DSC Item ID. The interface is annotated with a red box around the Parameters section, a green box around the FEA/FCAs line, and a blue box around the collapse button.

Using nCTOP

FCA Parameters

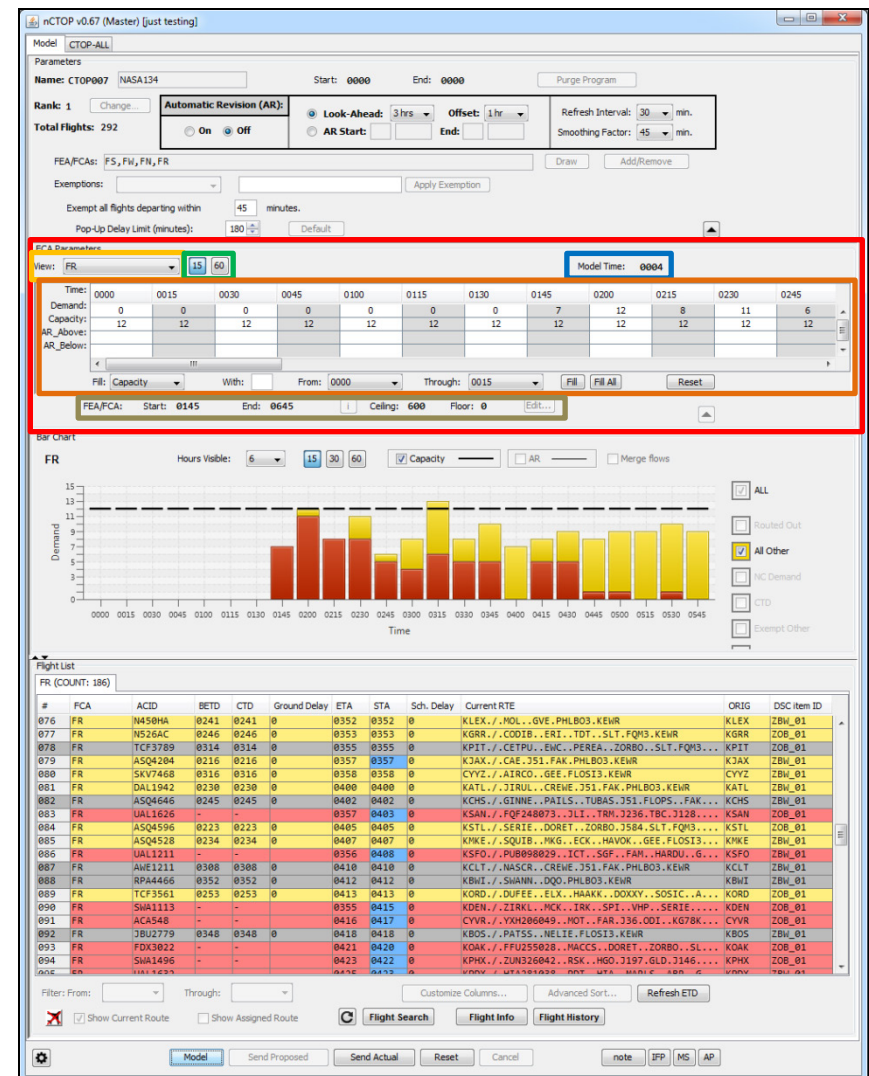
The next section is the **FCA Parameters** section which has several key functions. First, the **View dropdown menu** is what is used to select the FCA that the demand/capacity table, the Bar Chart, and the Flight List all correspond to.

The **15/60 buttons** are used to toggle the demand/capacity table to display in either 15-minute increments or 60-minute increments.

Model time shows the current UTC time.

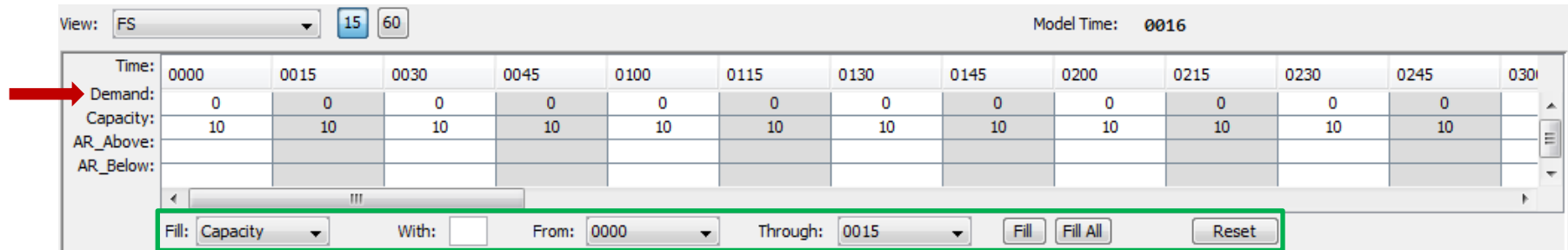
The **demand/capacity table** is where the user controls the aircraft demand as it crosses over the FCA. We'll talk about it more on the next page.

The **FEA/FCA section** provides some details about the currently selected FEA/FCA.



Using nCTOP

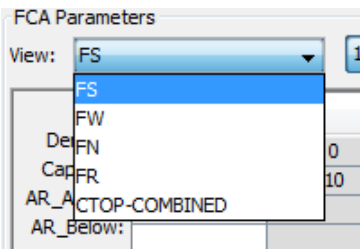
FCA Parameters Table



View: FS 15 60 Model Time: 0016

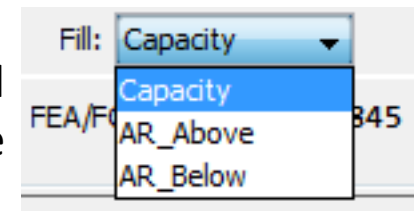
| Time: | 0000 | 0015 | 0030 | 0045 | 0100 | 0115 | 0130 | 0145 | 0200 | 0215 | 0230 | 0245 | 0300 |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Demand: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Capacity: | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| AR_Above: | | | | | | | | | | | | | |
| AR_Below: | | | | | | | | | | | | | |

Fill: Capacity With: From: 0000 Through: 0015 Fill Fill All Reset



As mentioned previously, the **View dropdown menu** selects the currently displayed FCA. In the **FCA parameters table**, the first line is the **Demand count** and shows the amount of aircraft crossing over the FCA at the UTC time indicated in the column headers.

The second line shows the **Capacity counts** in a similar fashion. These are values the user sets in order to constrain the demand to the entered values. Either enter the values in by hand, or use Fill/FillAll with the **appropriate settings**.



The AR_ABOVE and AR_BELOW lines are used for configuring Automatic Revision. They function exactly as they would in the actual CTOP program. For more information on Automatic Revision and the configuration options, see the Appendix.

FillAll

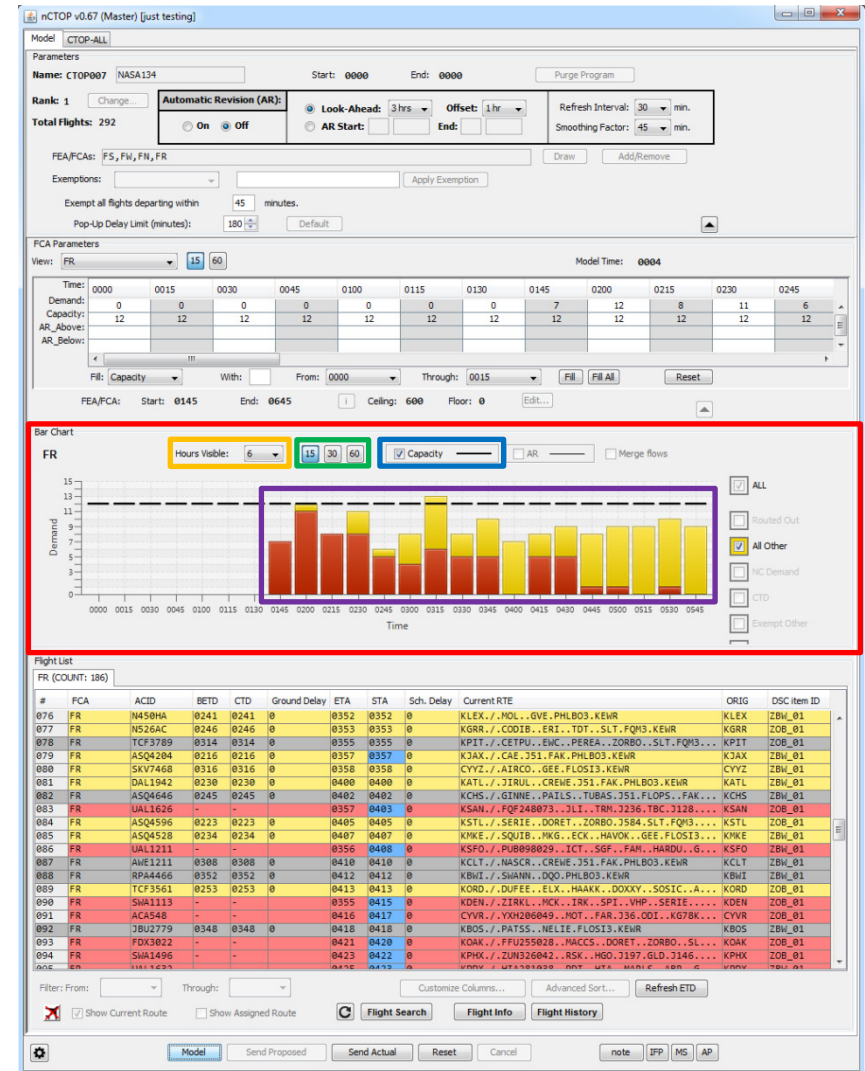
Using nCTOP

Bar Chart

The **Bar Chart** section is a visual representation of the FCA Parameters table. Additionally, it can show you the distinction between **Active** (in-flight) and **Inactive** (on the ground) aircraft, as well as a special mode called CTOP-COMBINED which shows multiple FCAs in a single chart (more on that later).

The **Hours Visible dropdown** allows you to select how many hours you want to show at once; the **15/30/60 buttons** allow you to toggle between showing increments of time in those respective amounts, and the **Capacity checkbox** toggles the display of the capacity values.

Additionally, you can also **select a bar in the chart** to display aircraft in the flight list associated only with that time (and FCA).

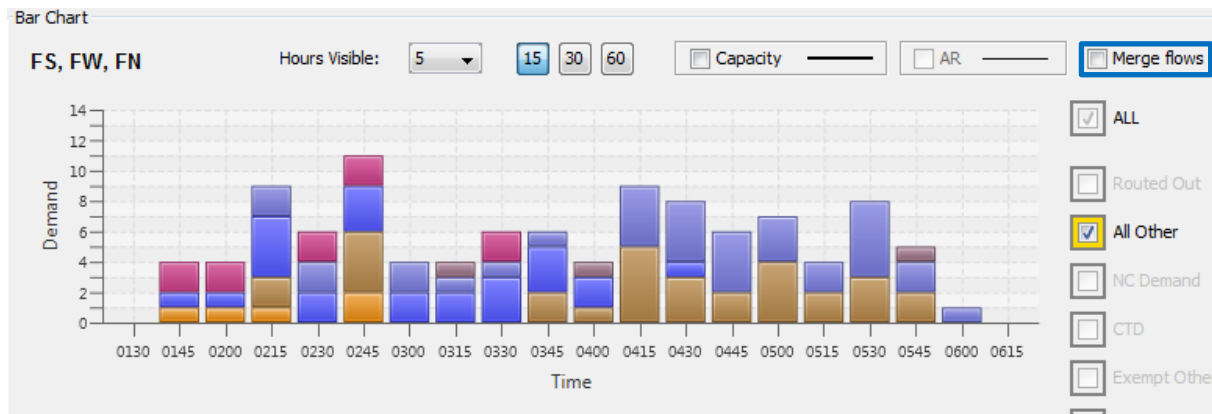


Using nCTOP

Bar Chart: **CTOP-COMBINED**

One aspect of the **Bar Chart** section that is not part of the actual CTOP application is a View option called “CTOP-COMBINED”. Effectively, it combines a group of FCAs (as specified in the settings) into a single bar chart with each of their active/inactive flows colored independently.

FCA Parameters
View: **CTOP-COMBINED** **15** **60**



The **Merge flows option** becomes available in this mode, which allows you to merge the all the active FCA data and all the inactive FCA data just to see the overall combined values.

Using nCTOP

Flight List

The **Flight List** section is a list of flights that cross the FCA. If you select a particular bar in the Bar Chart, it will show only those flights associated with crossing the FCA in that time bin.

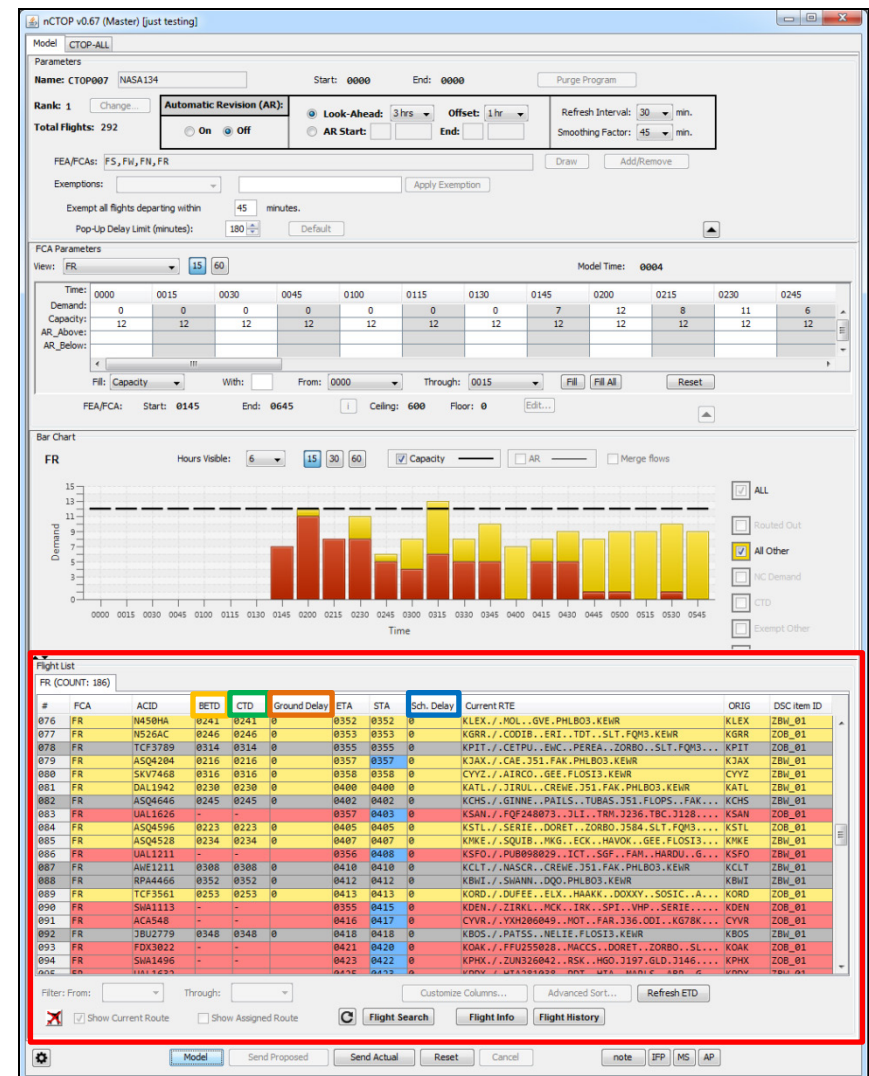
Most of the columns are self-explanatory, but a few require additional clarification:

BETD – Based Estimated Time of Departure, which is the first recorded *departure time* for that aircraft when nCTOP starts.

CTD – Controlled Time of Departure, which is the current departure time.

Ground Delay – The difference between the BETD and the CTD.

Sch. Delay – Scheduled delay is the difference between the initially recorded STA (not shown) and the current STA.



Using nCTOP

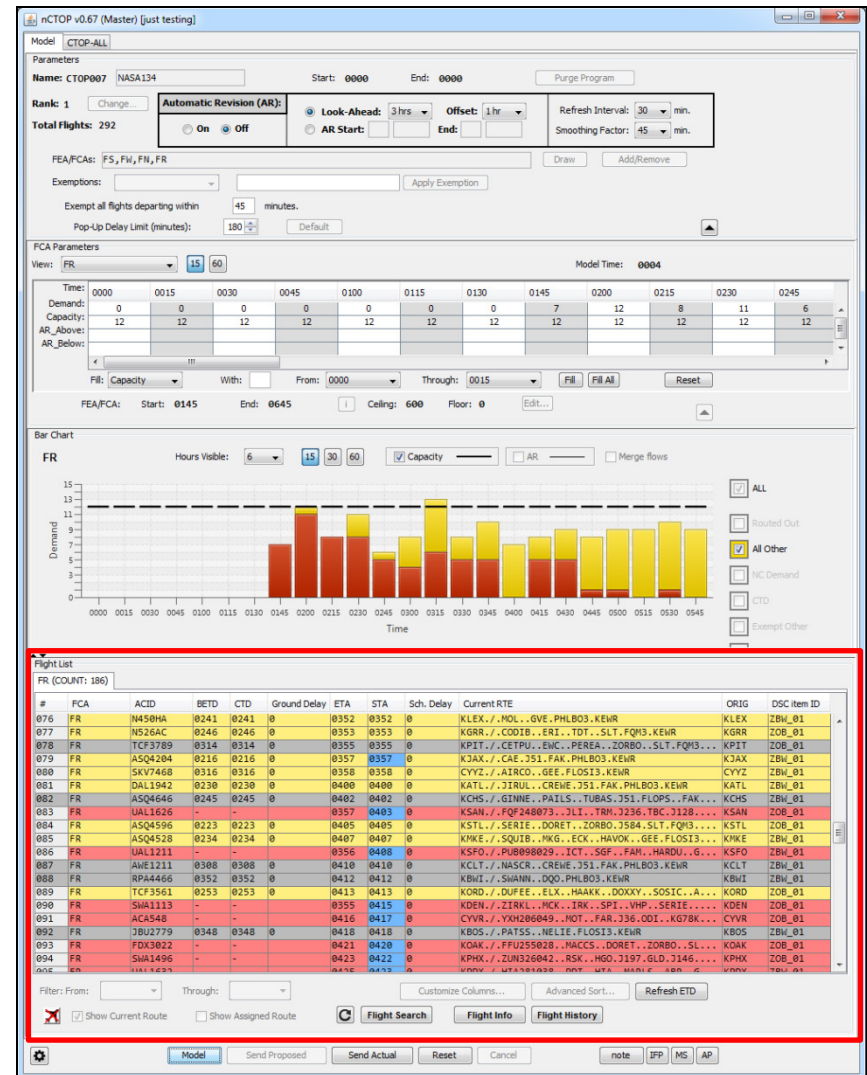
You may notice line coloring on the **Flight List** section which is not part of the actual CTOP application — this is a feature that can be enabled in the settings. By default:

- **inactive** aircraft are colored **yellow**
- **active** aircraft are colored **red**
- aircraft which **depart from a list of specified airports*** are colored **gray**

*This list is specified in the *Settings* panel

Lastly, STA values are given an **icy-blue** background when they are **frozen**.

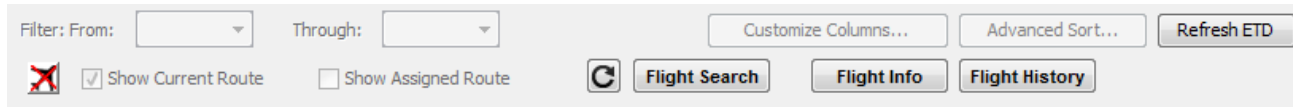
Flight List: Colors





Using nCTOP

Flight List: Buttonology

At the bottom of the **Flight List** section you'll notice some buttons:

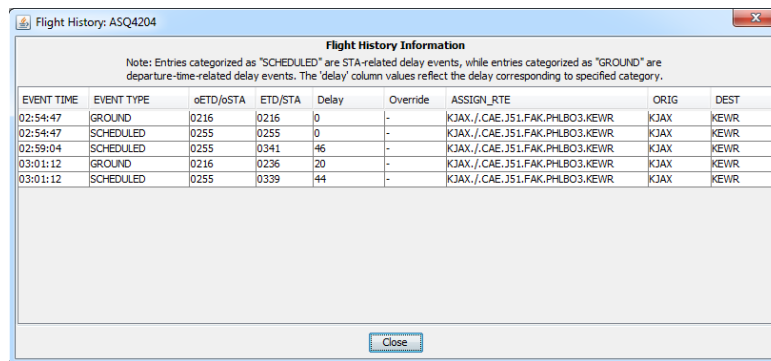


Filter: From: Through: Customize Columns... Advanced Sort... Refresh ETD

 ☒ Show Current Route ☐ Show Assigned Route  Flight Search Flight Info Flight History

The circular arrow button is the **Refresh** button. Use it if you've altered the display of the flight list in some way and you want to bring it back to the default display of all flights.

The **Flight Search** button allows you to search for flights. More than one flight can be searched for by separating the flights by a space, and it'll accept partial callsigns as well. So for example if you wanted to search for all Delta flights, simply search for "DAL".



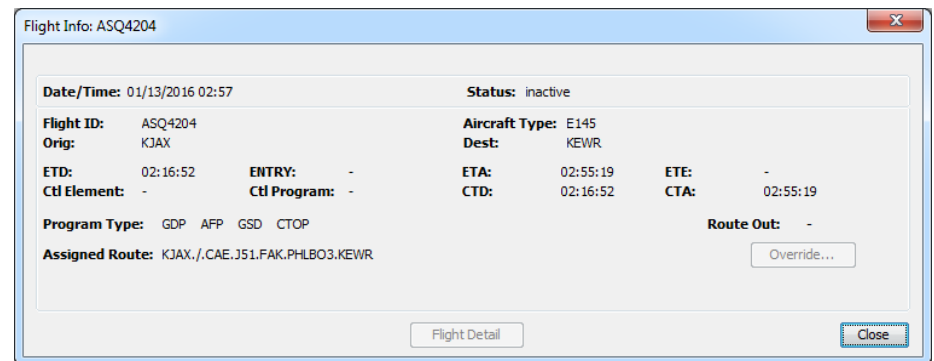
Flight History: ASQ4204

Flight History Information

Note: Entries categorized as "SCHEDULED" are STA-related delay events, while entries categorized as "GROUND" are departure-time-related delay events. The "delay" column values reflect the delay corresponding to specified category.

| EVENT TIME | EVENT TYPE | oETD/oSTA | ETD/STA | Delay | Override | ASSIGN RTE | ORIG | DEST |
|------------|------------|-----------|---------|-------|----------|-------------------------------|------|------|
| 02:54:47 | GROUND | 0216 | 0216 | 0 | - | KJAX./CAE.J51.FAK.PHLBO3.KEWR | KJAX | KEWR |
| 02:54:47 | SCHEDULED | 0255 | 0255 | 0 | - | KJAX./CAE.J51.FAK.PHLBO3.KEWR | KJAX | KEWR |
| 02:59:04 | SCHEDULED | 0255 | 0341 | 46 | - | KJAX./CAE.J51.FAK.PHLBO3.KEWR | KJAX | KEWR |
| 03:01:12 | GROUND | 0216 | 0236 | 20 | - | KJAX./CAE.J51.FAK.PHLBO3.KEWR | KJAX | KEWR |
| 03:01:12 | SCHEDULED | 0255 | 0339 | 44 | - | KJAX./CAE.J51.FAK.PHLBO3.KEWR | KJAX | KEWR |

Close



Flight Info: ASQ4204

Date/Time: 01/13/2016 02:57 Status: inactive

Flight ID: ASQ4204 Aircraft Type: E145
Orig: KJAX Dest: KEWR

ETD: 02:16:52 ENTRY: - ETA: 02:55:19 ETE: -
Ctl Element: - Ctl Program: - CTD: 02:16:52 CTA: 02:55:19

Program Type: GDP AFP GSD CTOP Route Out: -

Assigned Route: KJAX./CAE.J51.FAK.PHLBO3.KEWR

Override...

Flight Detail Close

The **Flight Info** and **Flight History** buttons display information dialogs: *Flight Info* shows detailed aircraft information while *Flight History* shows a record of departure time and STA changes. The **Refresh ETD** button simply re-captures baseline departure times and STAs, if for some reason there is a need to do so.

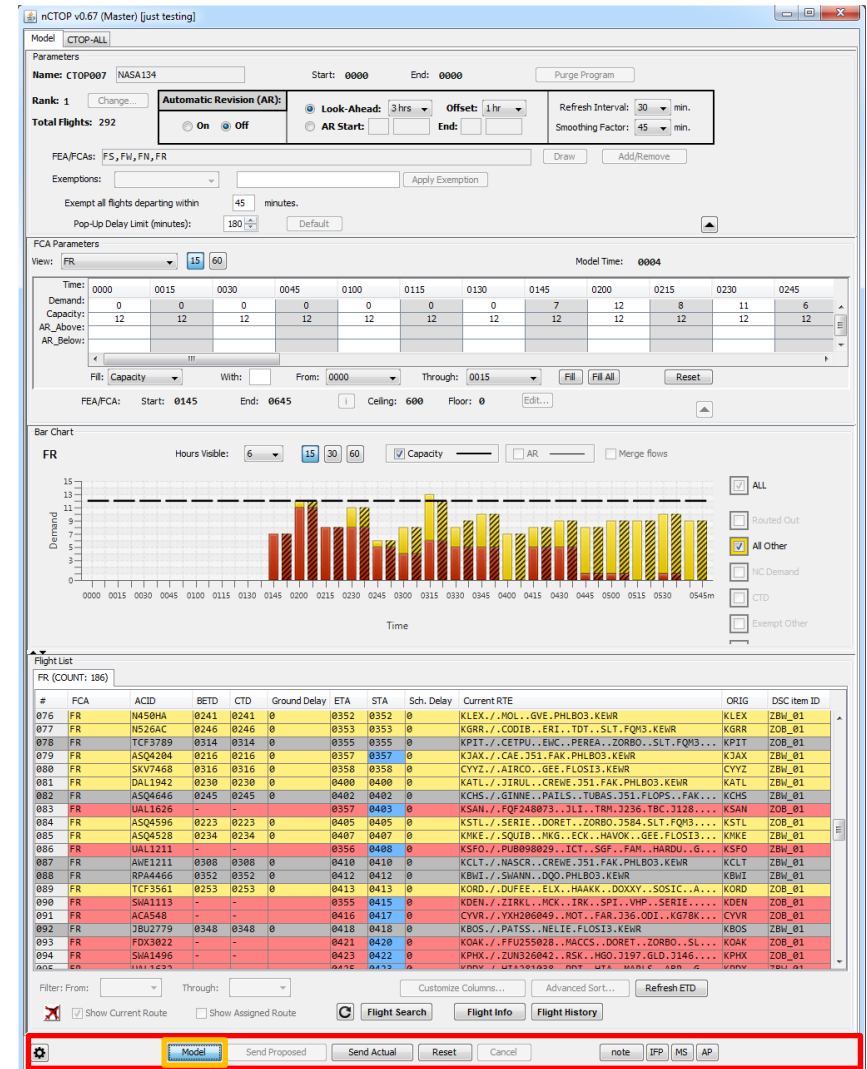
Using nCTOP

The Bottom Row: Part 1

The bottom row of buttons on nCTOP serve a number of important functions.

To start, the **Model** button adds an additional bar (striped) per time bin which is the demand capped at the capacity value. If demand exceeds capacity, any additional aircraft are moved to the following bin, with inactive aircraft always being moved first if possible.

Note that the resulting distribution of striped bars is an “ideal” projected distribution; how the aircraft ultimately fly in the simulation software may vary due to unforeseeable factors, such as departure delays, non-compliance, weather, etc.



Using nCTOP

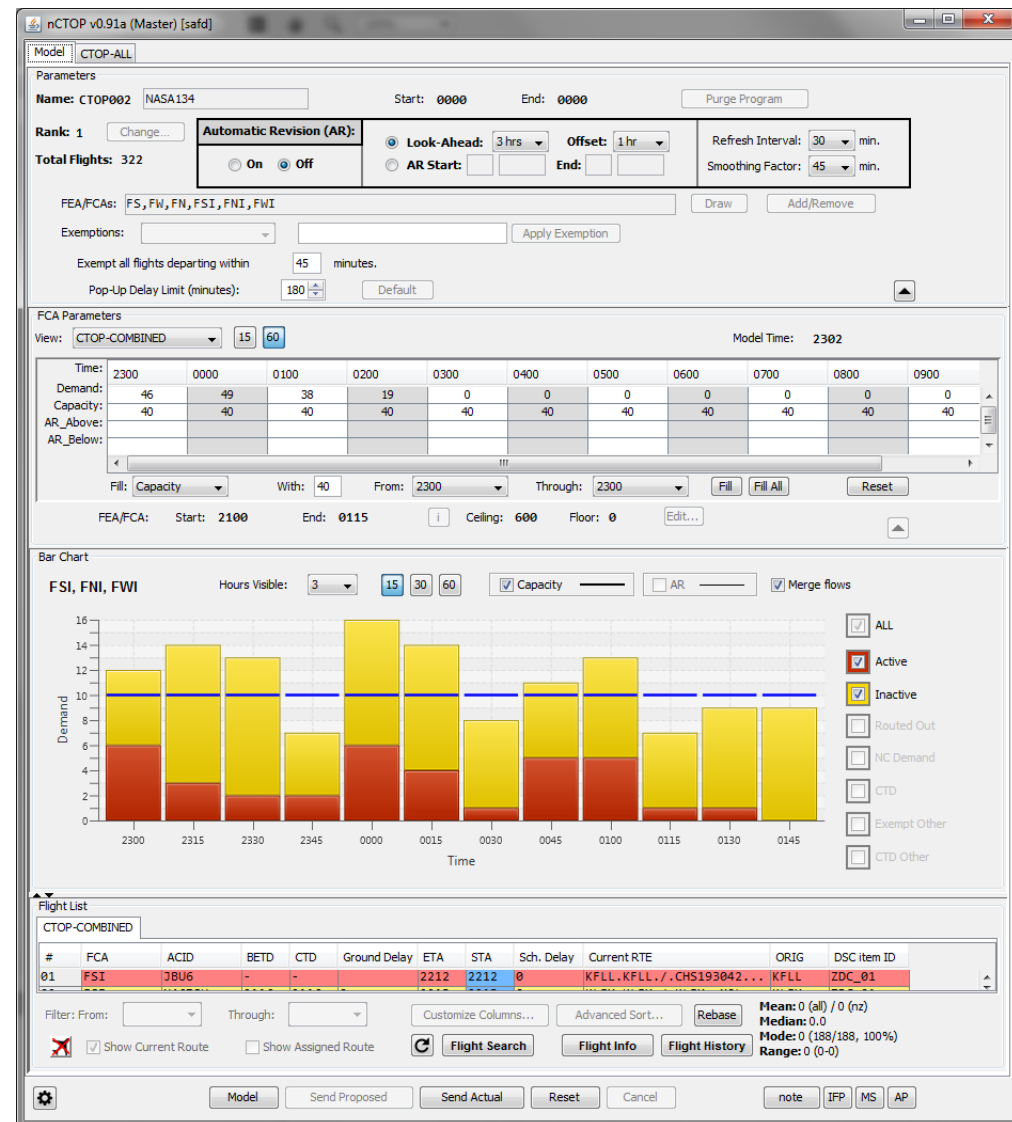
Modeling: Algorithm

There's an interesting feature that I will touch upon in more detail later that pertains to modeling: an algorithm we have the option of using which balances capacity values to an established rate based on the demand across multiple flows.

It's best described with an example:

Let's say we want to set a 40 rate at EWR. We enter 40 and it calculates we need to limit EWR to 10 aircraft max every 15m time bin*. The question is, when looking at a combined flow, where do you distribute capacity values?

We let the algorithm determine capacity values based on demand proportion every 15m.



Let's say at a given time T there is:

2 from the North

4 from the West

6 from the South

This makes a total **demand of 12**.

$2/12 = .1666666666$, or 16.66% from the North

$4/12 = .3333333333$, or 33.33% from the West

$6/12 = .5$, or 50% from the South

Now, let's say we want our **capacity** for this time to be **13**.

This means we want to allocate 16.66% of our total capacity allowance to the North, 33.33% to the West, and 50% to the South.

$.16666666 \times 13 = 2.1666658$ aircraft, which rounds to 2 (so North flow gets capacity of 2)

$.33333333 \times 13 = 4.33333329$ aircraft, which rounds to 4 (so West flow gets capacity of 4)

$.5 \times 13 = 6.5$, which rounds to 7 (so South flow gets capacity of 7).

$2 + 4 + 7 = 13$, so we're good here.

Now let's set the capacity for that bin to **12** instead.

$.16666666 \times 12 = 1.99999992$, which rounds to 2 (so North flow gets capacity of 2)

$.33333333 \times 12 = 3.99999996$, which rounds to 4 (so West flow gets capacity of 4)

$.5 \times 12 = 6$ (so South flow gets capacity of 6).

$2 + 4 + 6 = 12$, so we're good here.

Capacity of **11**:

$.16666666 \times 11 = 1.833333326$, which rounds to 2

$.33333333 \times 11 = 3.666666663$, which rounds to 4

$.5 \times 11 = 5.5$, which rounds to 6.

Oops... $2 + 4 + 6 = 12$ again, instead of 11.

- If we have excess capacity, we look for the flow with the lowest fractional component and subtract 1 from it.
- If we are under capacity, we look for the flow with the highest fractional component and add 1 to it.

Capacity of **11**:

$.16666666 \times 11 = 1.833333326$ aircraft, which rounds to 2

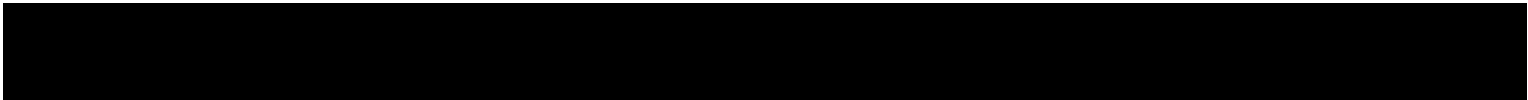
$.33333333 \times 11 = 3.666666663$ aircraft, which rounds to 4

$.5 \times 11 = 5.5$ aircraft, which rounds to 6.

$2 + 4 + 6 = 12$

5.5 has the lowest fractional component (normally rounds to 6)

So we subtract 1 from the capacity allowance.



If demand is 0 at a given time, we assume it's at least 1 to give it at least 1 capacity and some portion of slack capacity if it exists.

Demand of **3**:

$0/3 = 0$, or 0% from the North

$2/3 = .66$, or 66% from the West

$1/3 = .33$, or 33% from the South

Capacity of **14**:

$0 \times 14 = 0$ aircraft (0 extra slots)

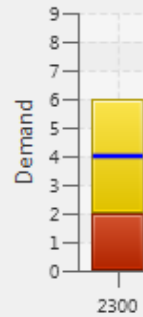
$.66 \times 14 = 9.24$ aircraft, which rounds to 9 (7 extra slots)

$.33 \times 14 = 4.62$ aircraft, which rounds to 5 (4 extra slots)

$0 + 9 + 5 = 14$

But the North flow got 0 zero allocation of slack capacity, whereas we might want to build in slack even when we see no demand (**so we give it 1 for now**).

FBI



De Demand: 4+2=6 South, 3 North, 7 West

12 14+2=16 total: 37.5% South, 18.75% North, 43.75% West

10 10 Capacity to distribute.

.5 .375 x 10 = 3.75 (rounds to 4)

.25 .1875 x 10 = 1.875 (rounds to 2)

.25 .4375 x 10 = 4.375 (rounds to 4)

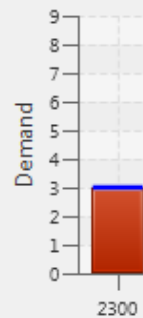
5 - 4 + 2 + 4 = 10

FC

FNI



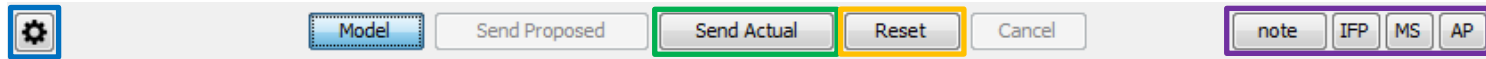
FWI



Time

Using nCTOP

The Bottom Row: Part 2

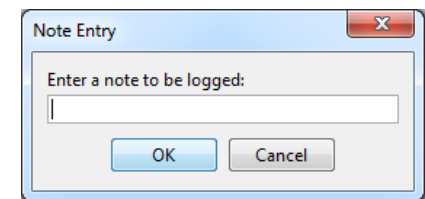


The **gear button** is the button to access nCTOP's **Settings panel**. Only researchers need access this area in order to setup nCTOP for the experiment.

The **Send Actual** button is used to send entered Capacity values for all FCAs to MACS (the flight simulation software). You'll notice that when changing capacity values, the capacity line is **blue** on the Bar Chart. This means the FCA capacity values have been changed. When Send Actual is clicked, the bars turn **black**, indicating the values in nCTOP now mirror the values in MACS.

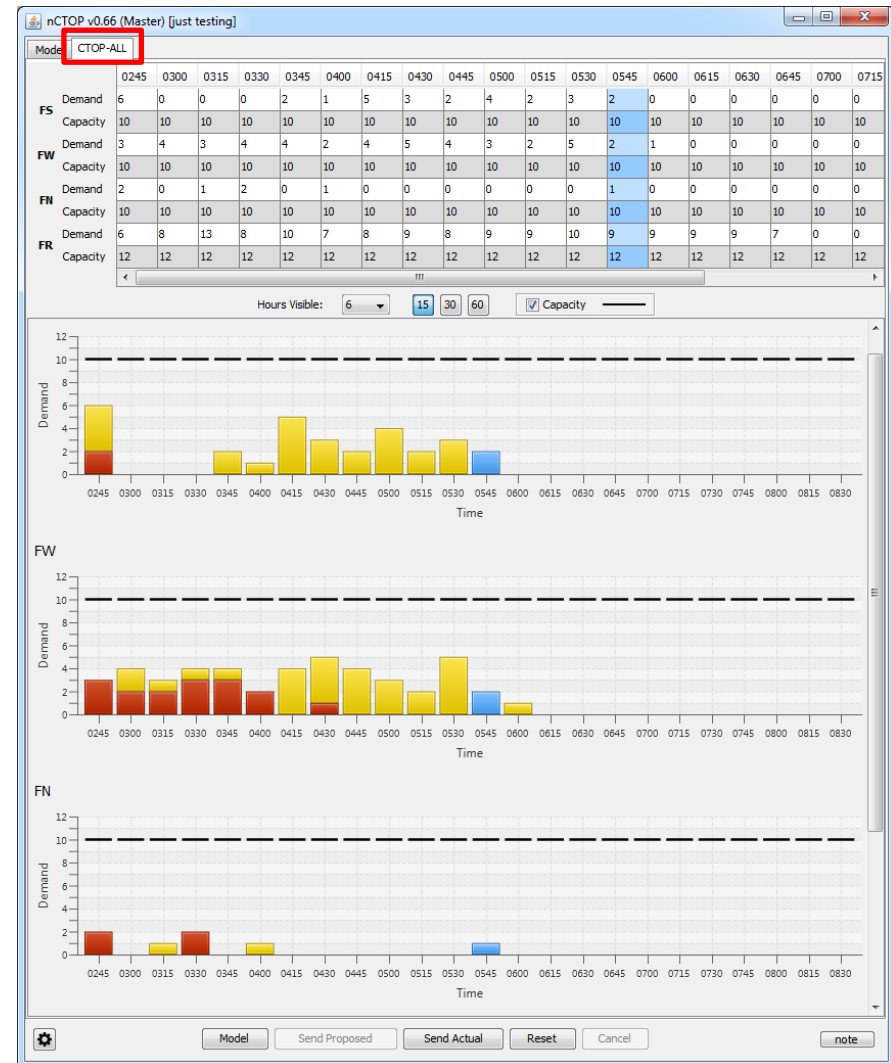
The **Reset** button resets any entered Capacity values to their previous, unaltered states and clears any AR_ABOVE/AR_BELOW values. Note: the difference between the Reset button here vs. the reset button in **FCA parameters** is that the former resets *all* FCAs, whereas the latter resets only the currently viewed FCA and doesn't affect the AR values.

The **Note** button allows users to enter notes directly into the log file. This is useful for informing the researchers of particular events that occurred or anything else you think they should know. The IFP/MS/AP buttons can be used to instantly create a log event message prior to issuing the IFP/MS/AP commands in MACS.



CTOP-ALL

One useful feature of this is that you can select any bar in any of the graphs to select all equivalent bars in the other graphs, as well as the highlight the same time column in the table. This allows for rapid comparison of FCA flow characteristics across multiple FCAs.



Using nCTOP

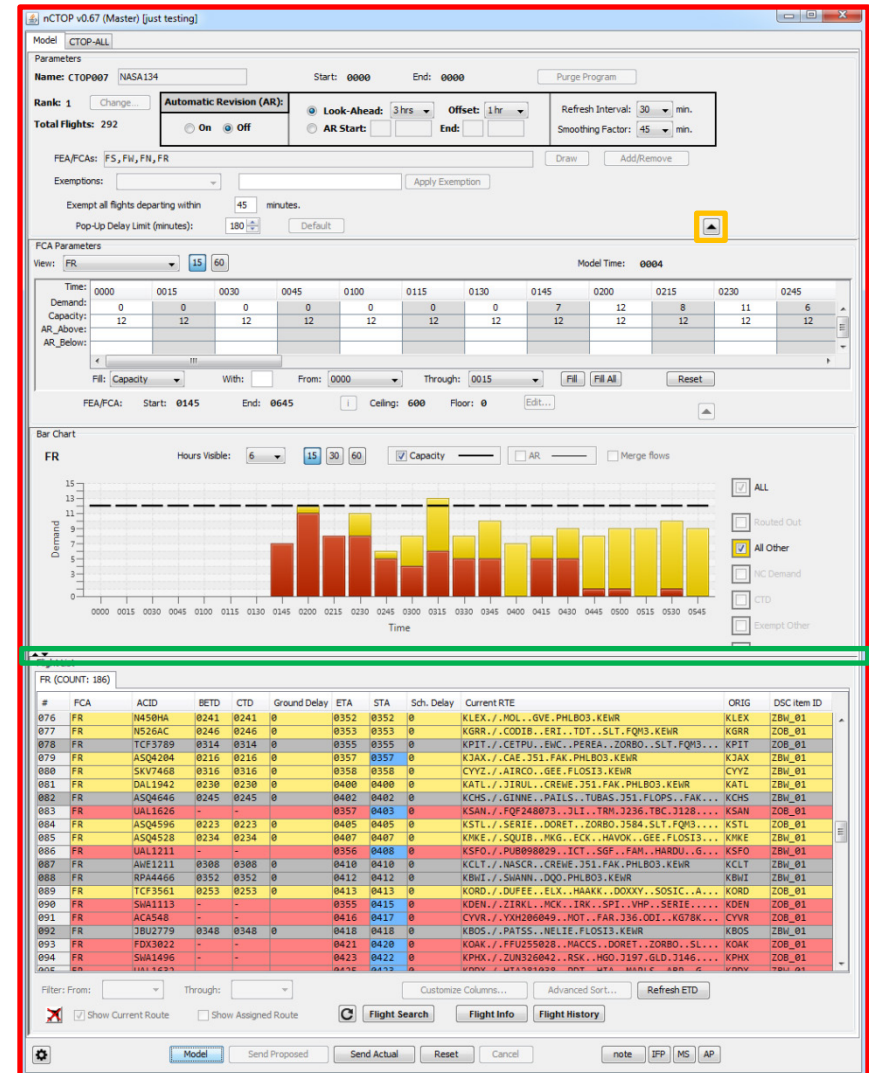
Resizing nCTOP

It can be useful to note that nCTOP is resizable in a number of ways.

Firstly, the top section can be collapsed with the **collapse button** if it is not needed.

Furthermore, the **line between the Bar Chart and Flight List** is adjustable, allowing you to resize either as needed.

Lastly, the **entire frame of the application** can be resized as needed to allow for even more (or less) space.





More Information

If you have any questions or simply would like more information about nCTOP, contact the developer:

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NASA Ames Research Center

nathan.buckley@nasa.gov

+1 (650) 604-5198

NASA Integrated Demand Management (IDM)

TBFM Configuration for KEWR
Developed for IDM Simulations at NASA Ames
as of March 2016 Demo

April 19, 2016



Contents

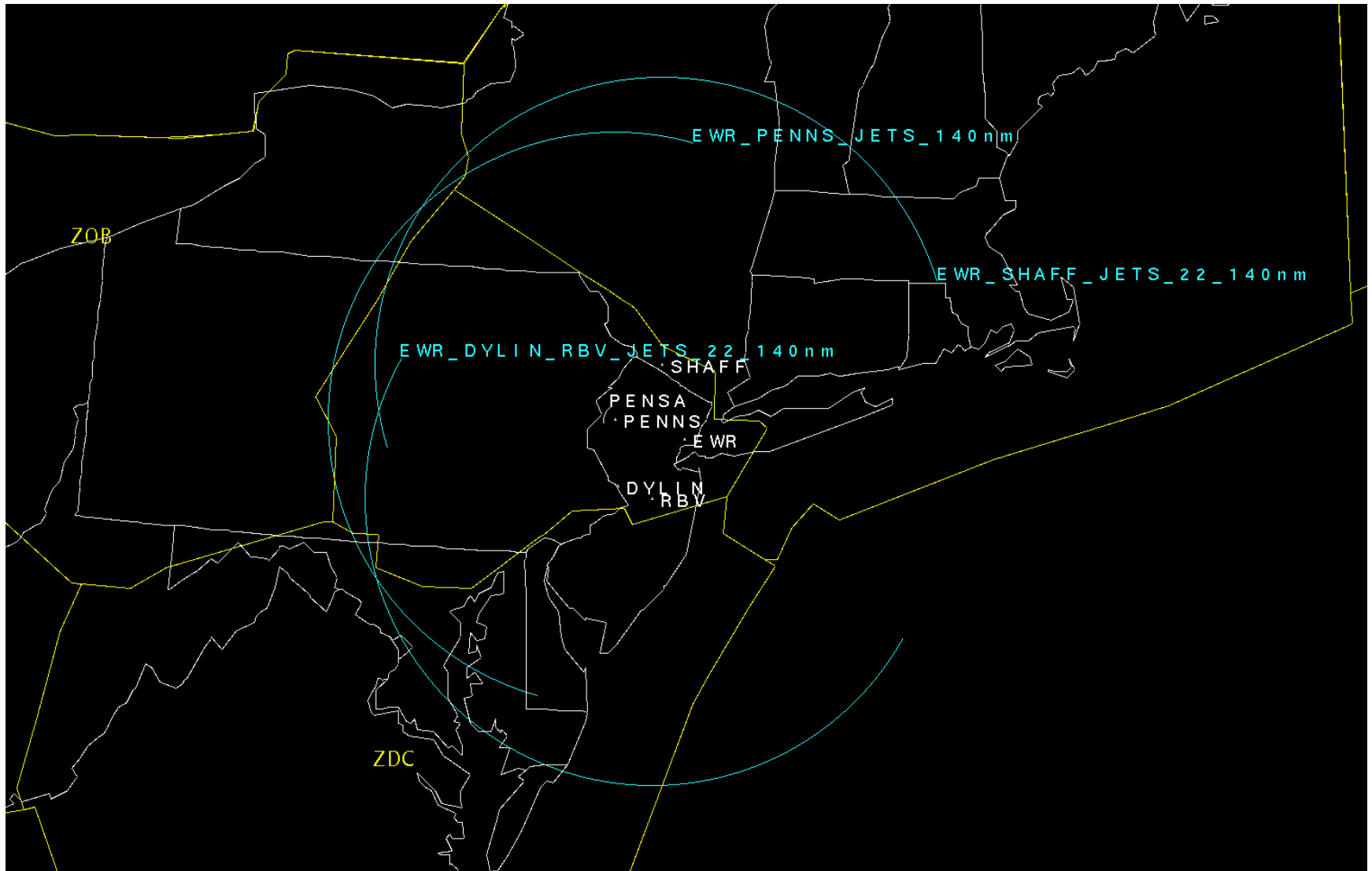
- Overview of TBFM Adaptation Architecture
- Justification for Placement of TBFM Elements
- Overview of Delay Distribution Parameters
- Adapted Internal Departure Airports

Overview of TBFM Adaptation Architecture

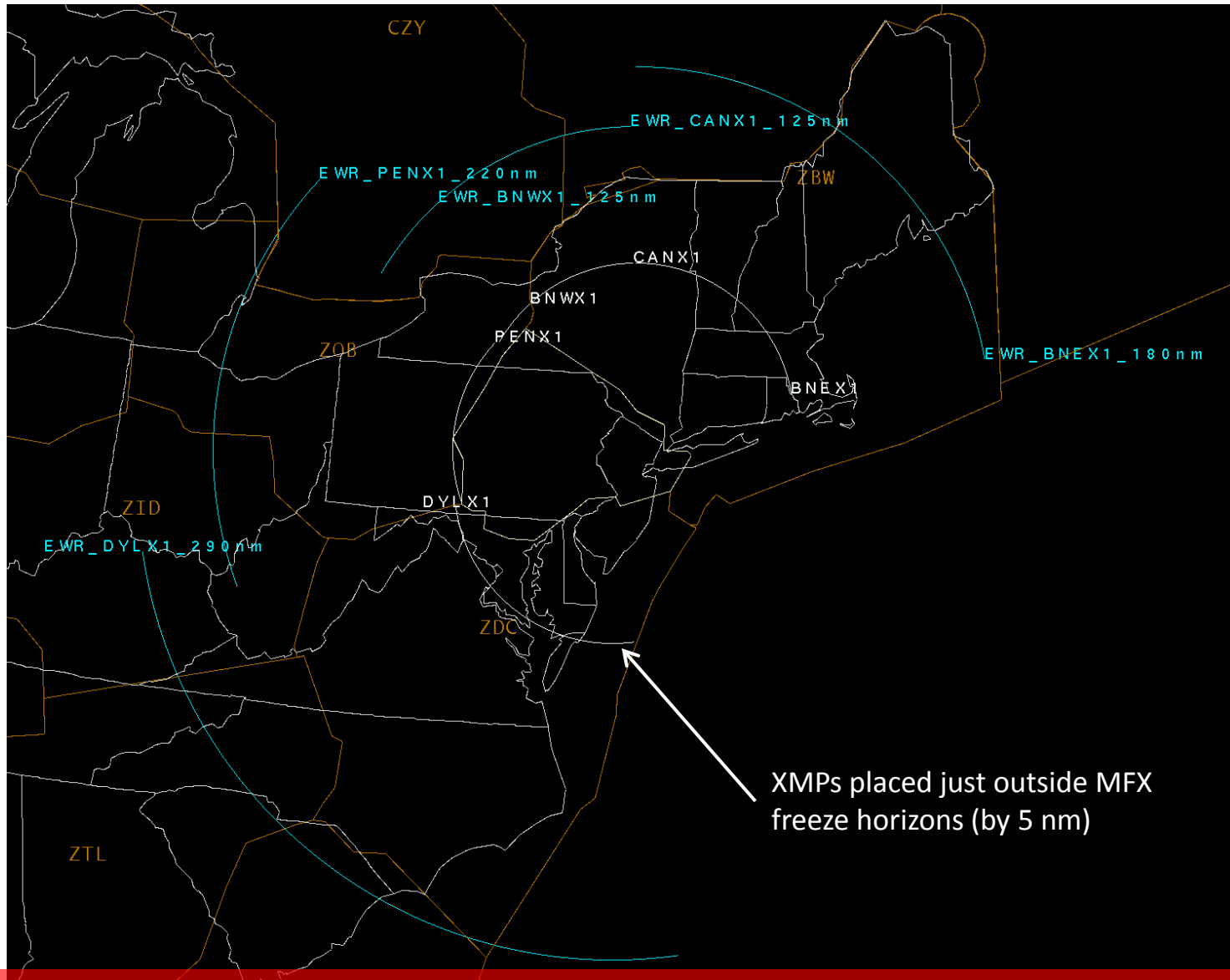
Summary: TBFM Adaptation Design and Software

- Two-tiered system includes:
 - Selected primary, current Meter Fixes (MFXs): SHAFF, PENNS, DYLIN, RBV (Arrival System / “N90” adaptation)
 - Custom, NASA-defined Extended Metering Points (XMPs) (En Route System / “EDC” adaptation)
- Rolling freeze: MFX freeze horizons do not overlap XMPs.
- Justification for use of Extended Metering (XM) vs. Coupled Scheduling (CS):
 - CS requires the sequence of unfrozen aircraft at the upstream coupled point to be enforced at the associated downstream coupled point.
 - XM does not impose this type of sequence enforcement, and was therefore selected to create a more flexible, less closely linked arrangement between the Arrival and En Route systems.
 - Coupled Scheduling may be implemented in future HITLs based on discussions with SMEs and stakeholders.
- Software: TBFM 4.2.3 modified by NASA to include Terminal Sequencing And Spacing (TSAS) capability

Overview: MFXs and Freeze Horizons

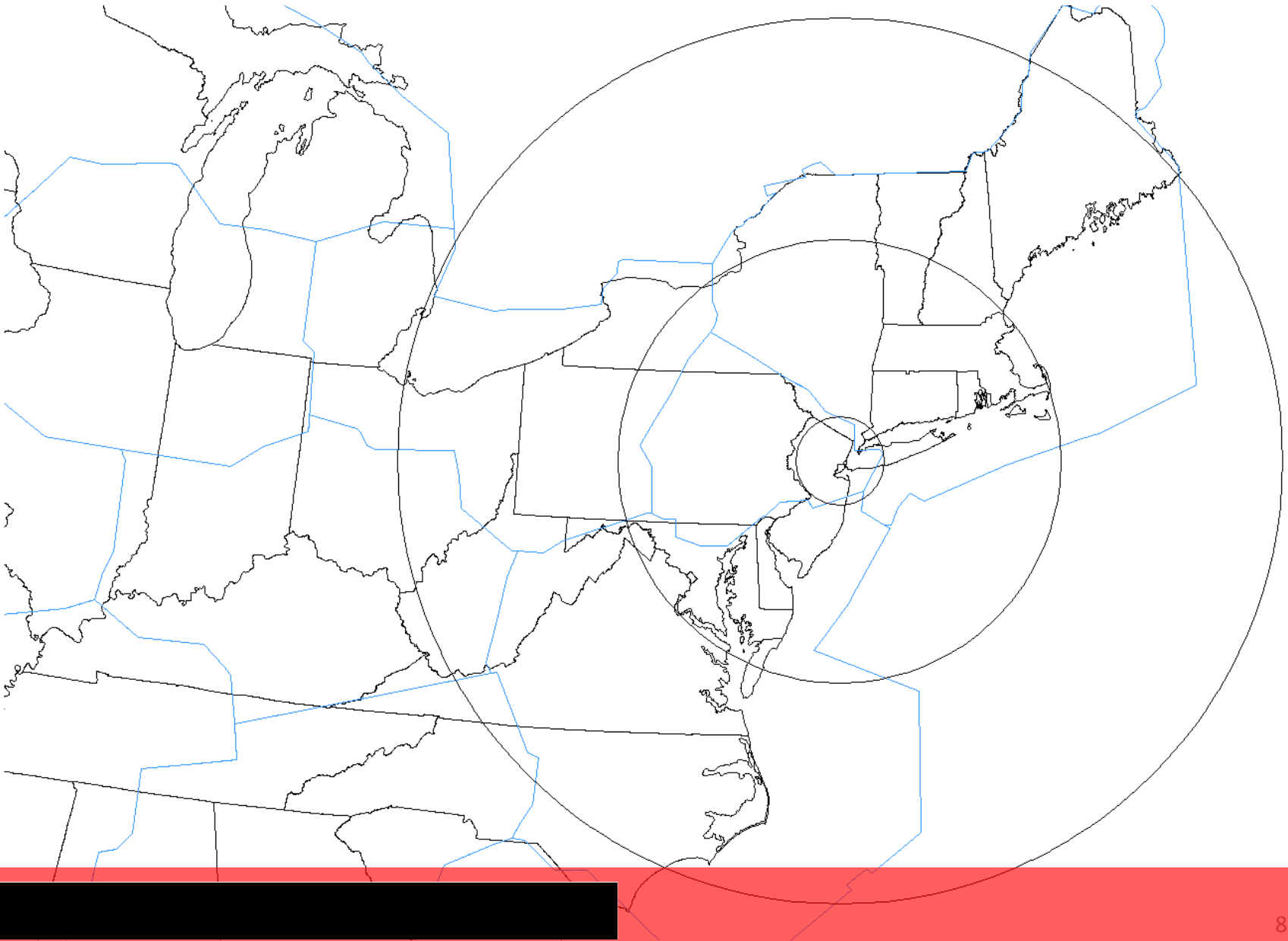


Overview: XMPs and Freeze Horizons

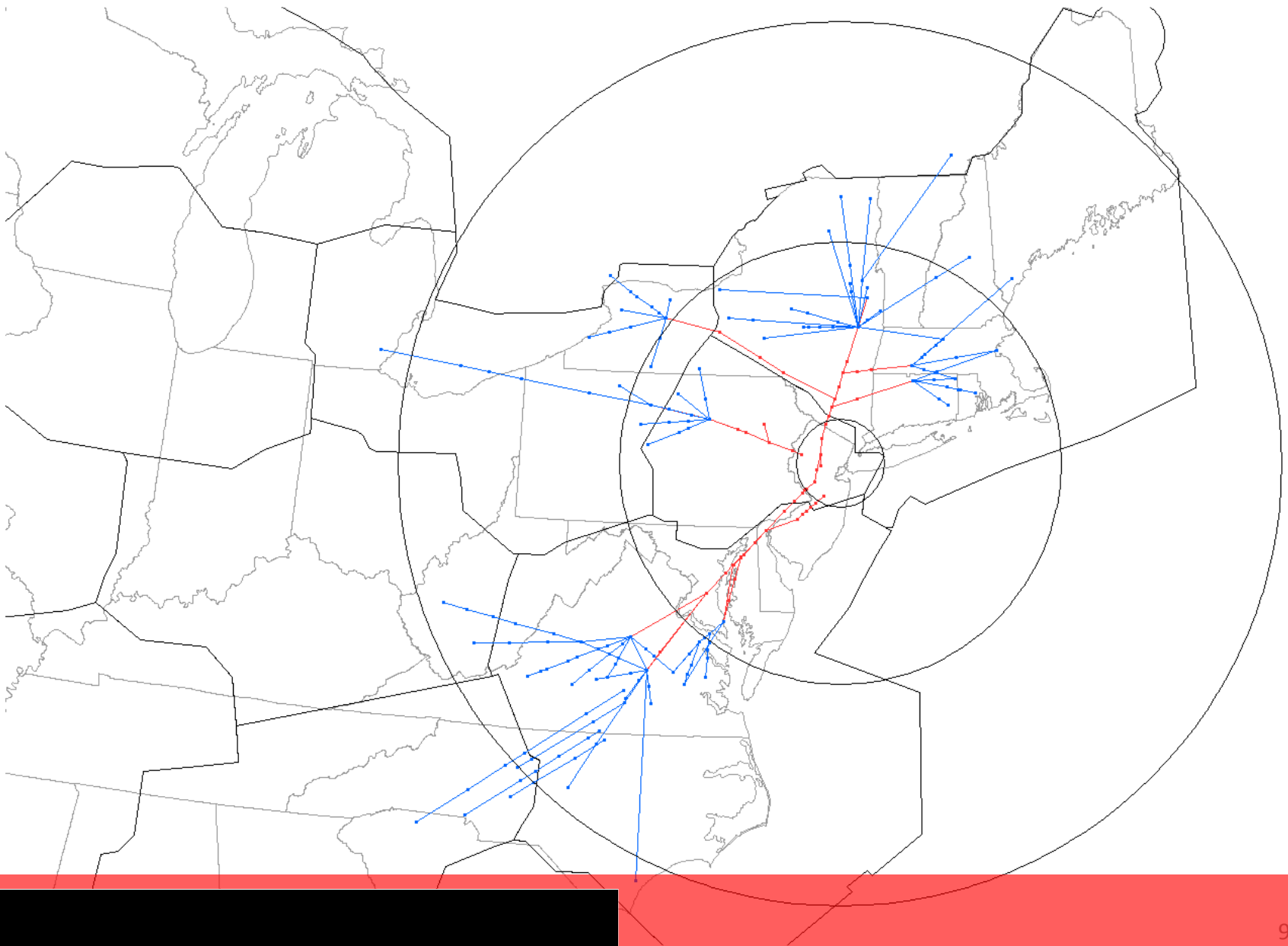


Justification for Placement of TBFM Elements

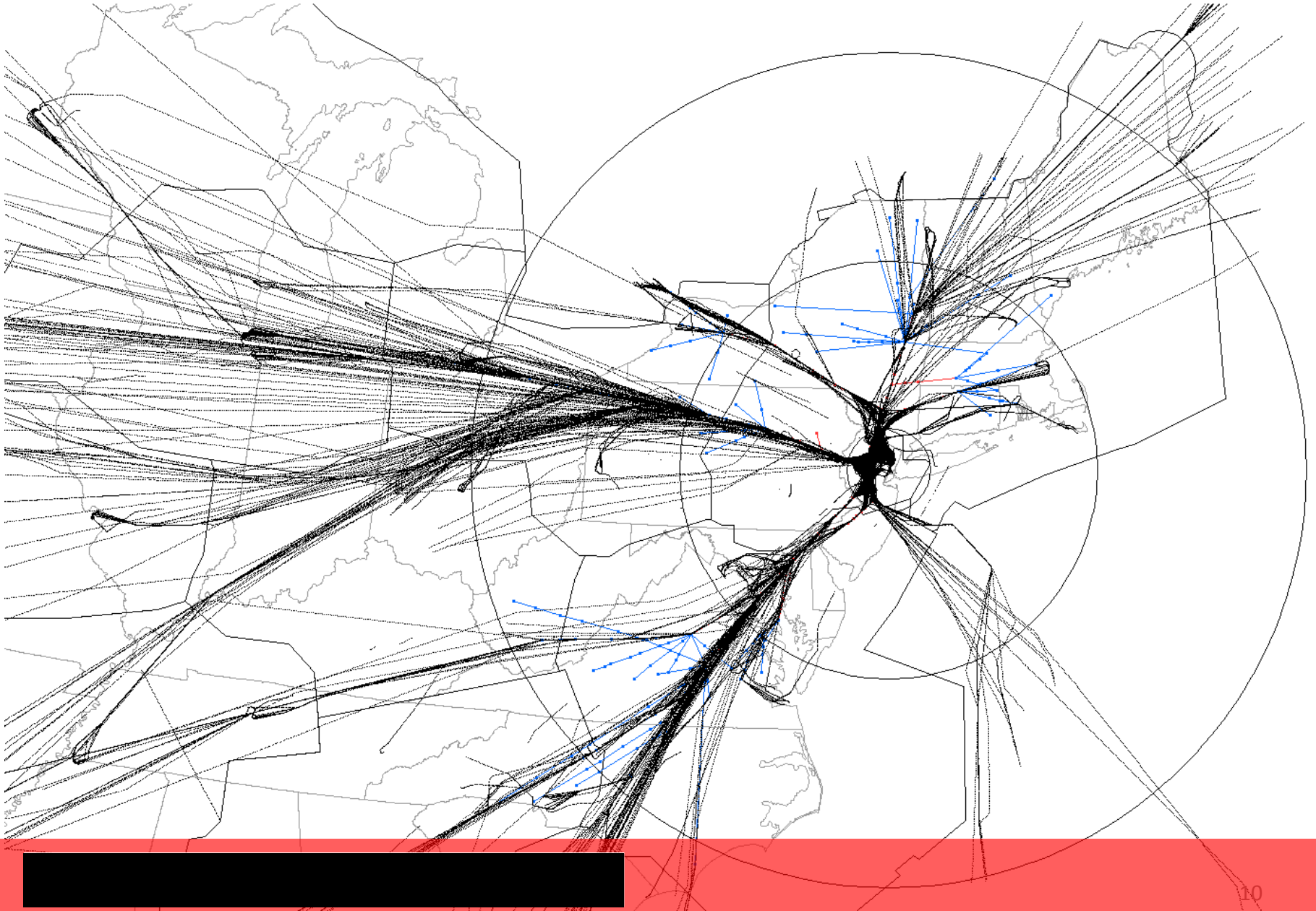
EWR Ranges: 40/200/400 nm



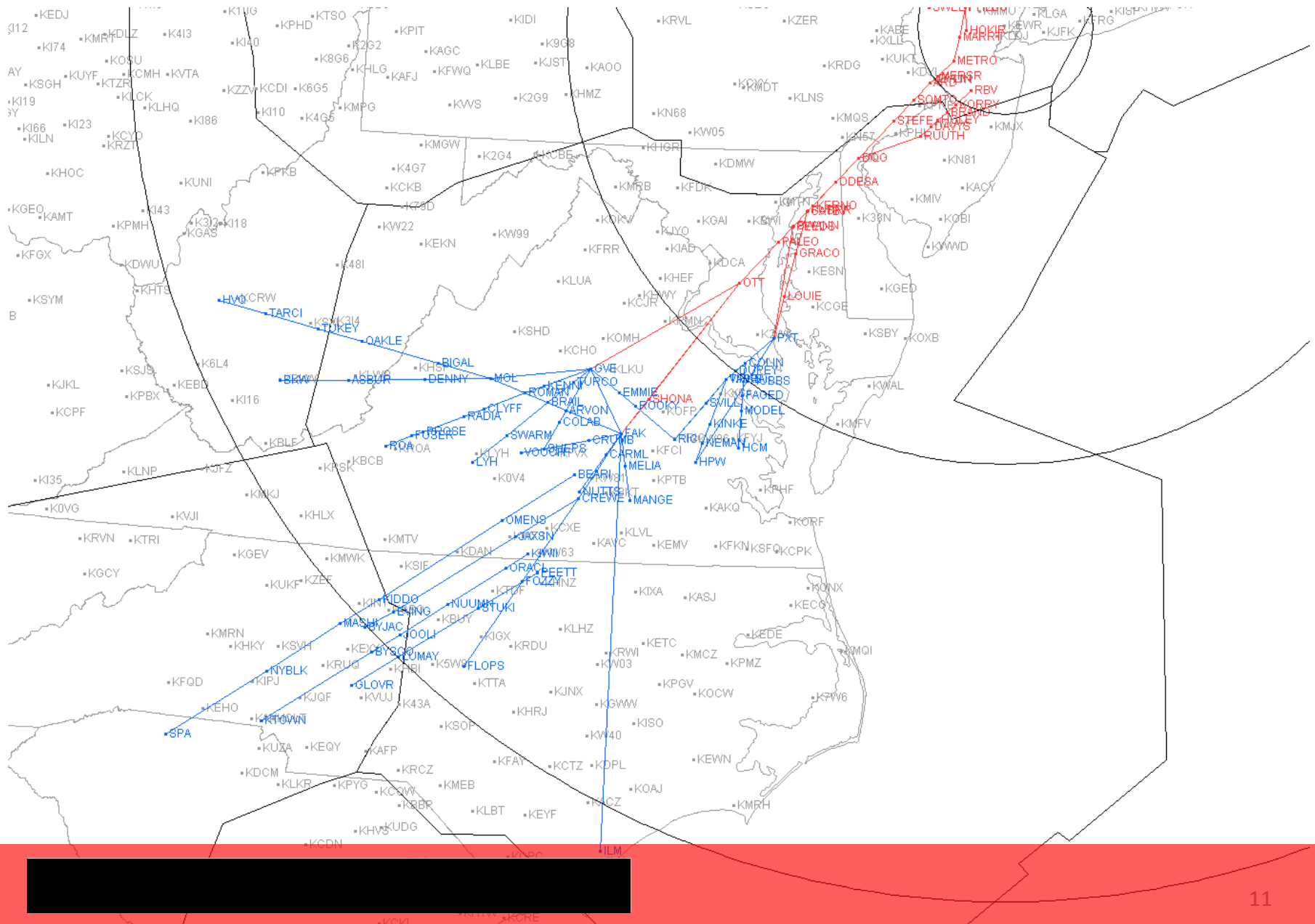
STARs (red) and Connecting Airways (blue)



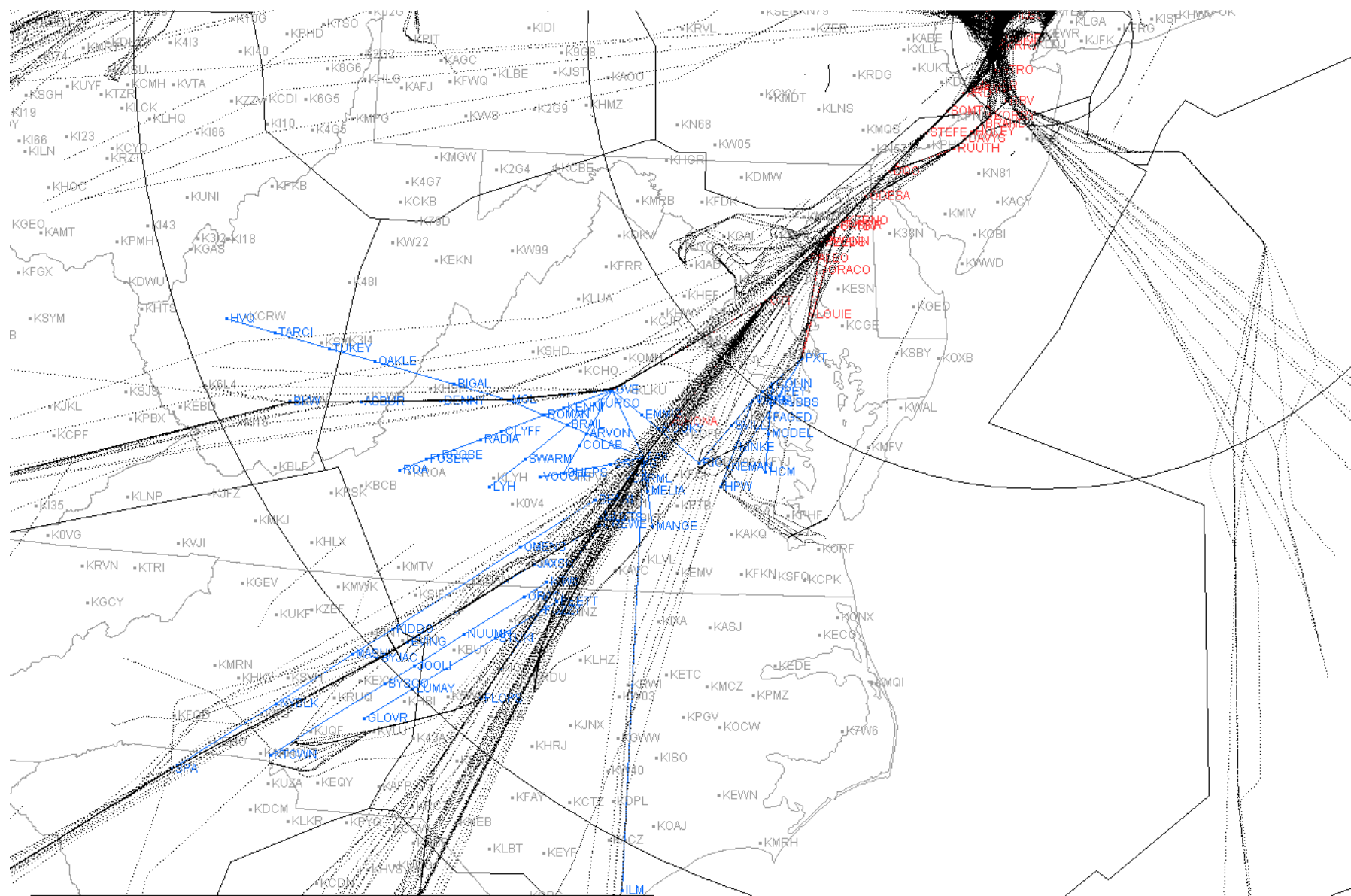
Traffic: 07/22/2014



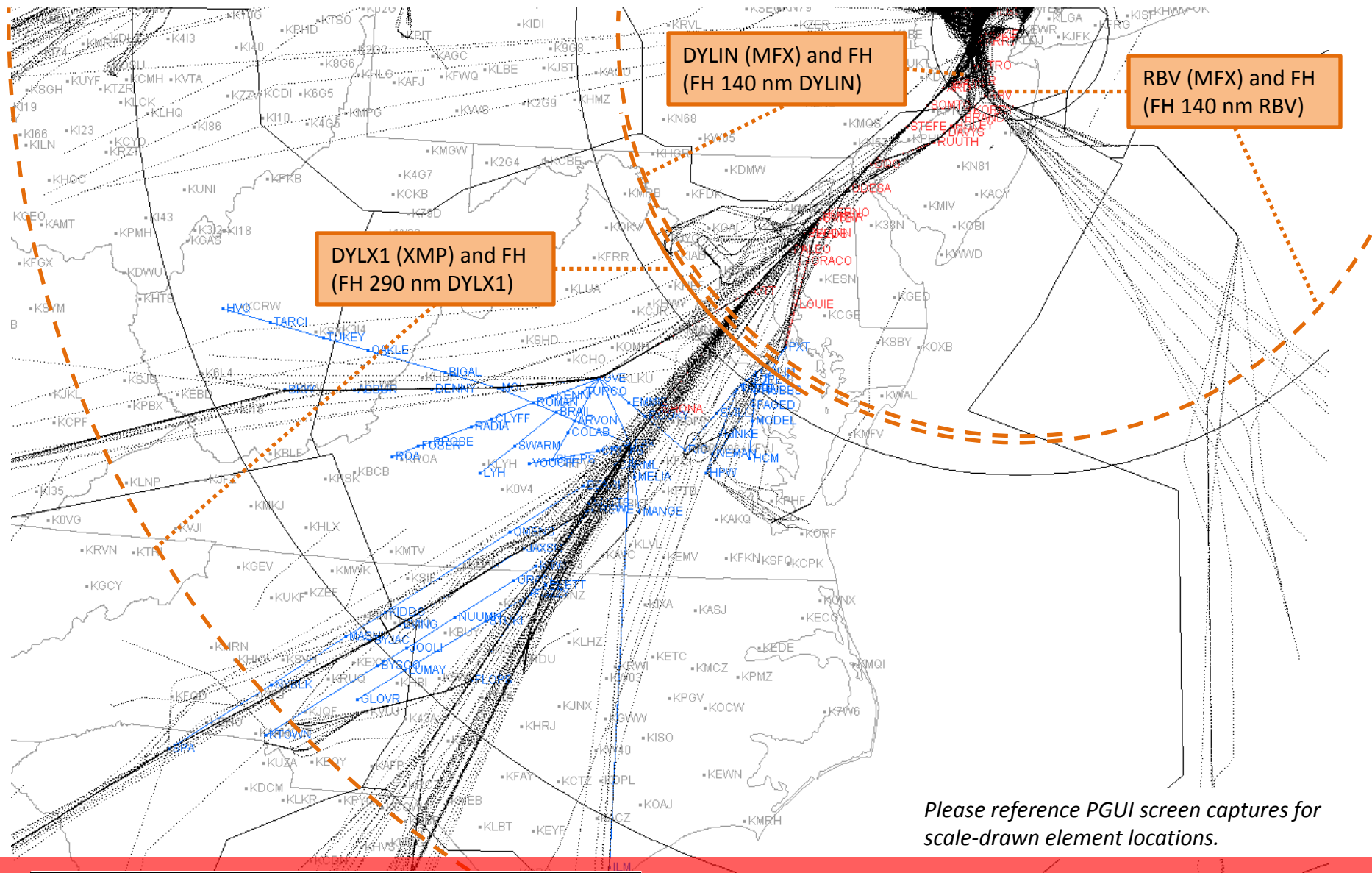
ZDC Detail



ZDC Flows – 07/22/2014



ZDC Flows: XMP/FH Locations

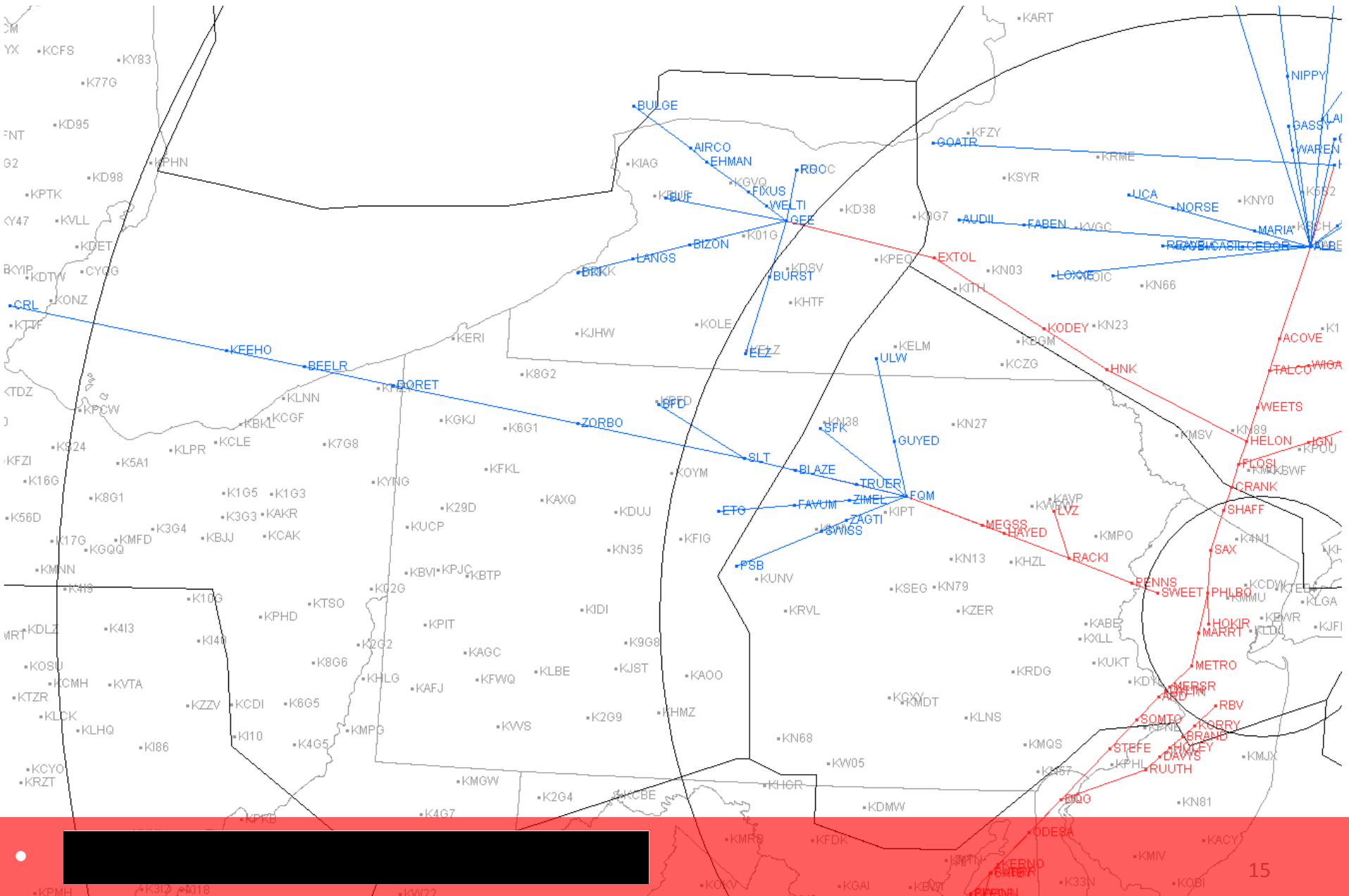


Metering Reference Element (MRE) Placement

MFxs: DYLIN, RBV

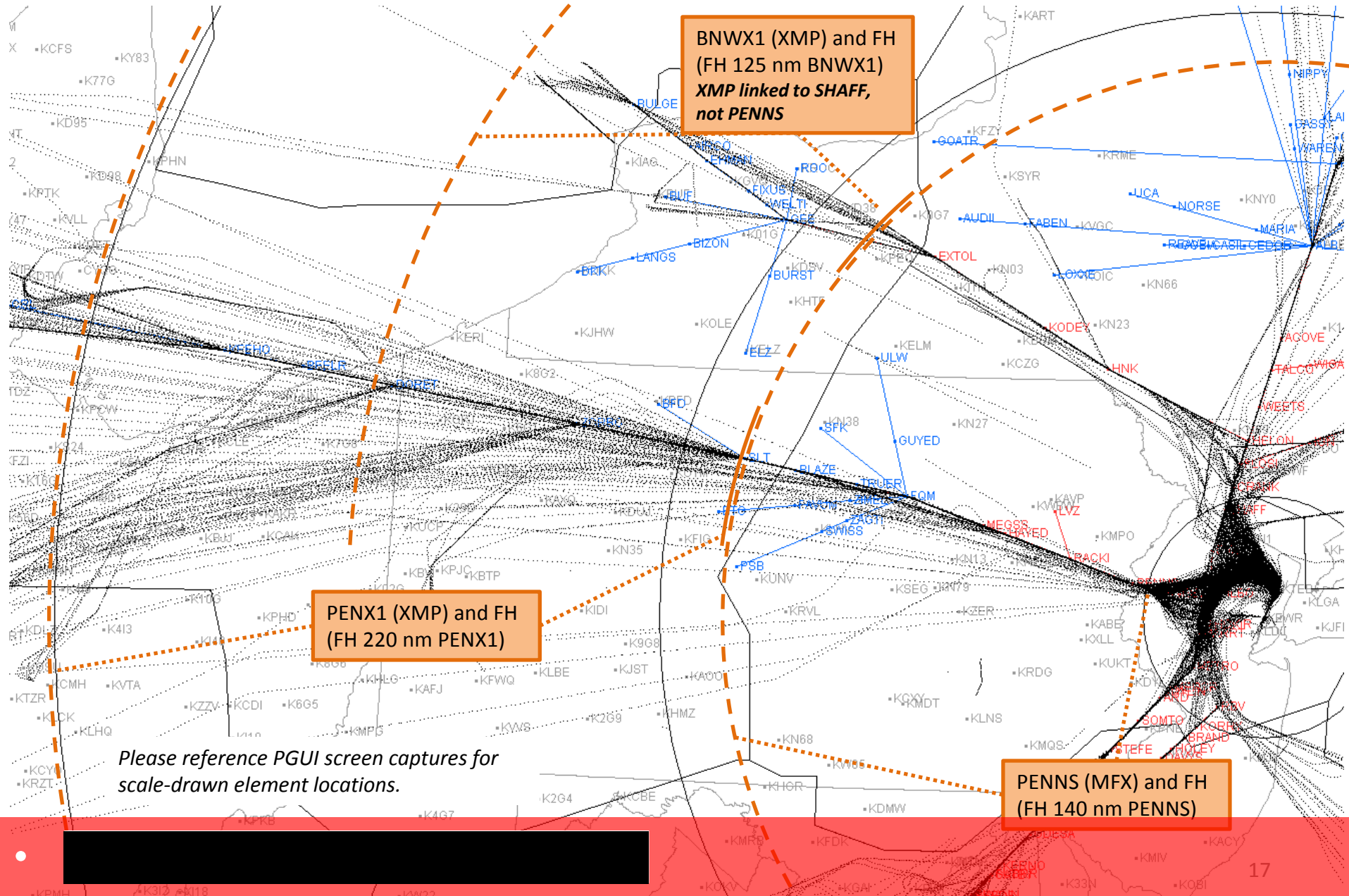
| MRE | Placement | Justification |
|--------|--------------|---|
| MFx | DYLIN | Existing |
| MFx FH | 140 nm DYLIN | Consistency with PENNS FH |
| MFx | RBV | Existing |
| MFx FH | 140 nm RBV | Consistency with PENNS FH |
| XMP | DYlX1 | Just outside DYLIN FH |
| XMP FH | 290 nm DYlX1 | ZDC/ZJX boundary, max. delay absorption |

ZOB Detail



ZOB Flows – 07/22/2014

ZOB Flows: MP/FH Locations

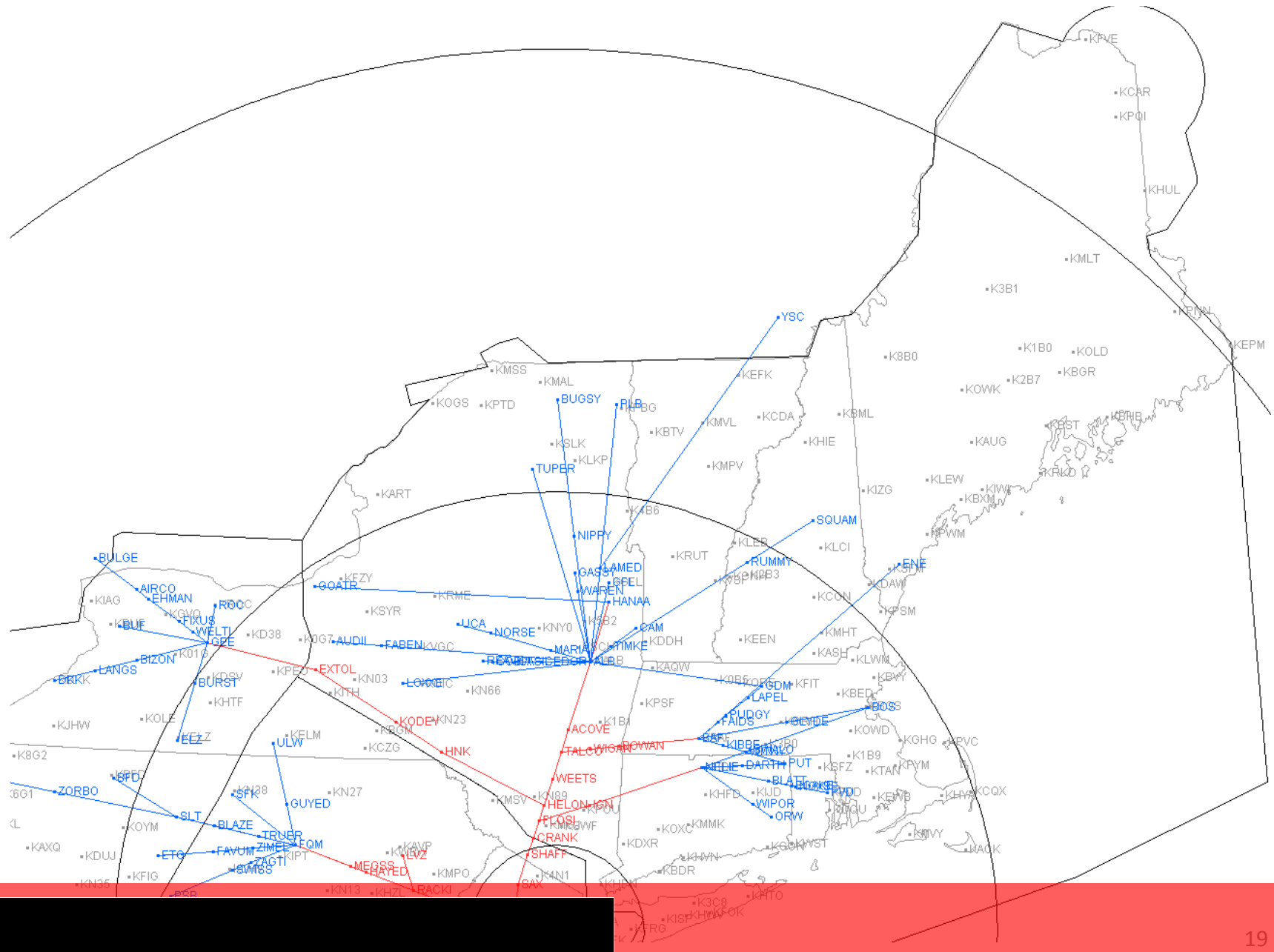


Metering Reference Element (MRE) Placement

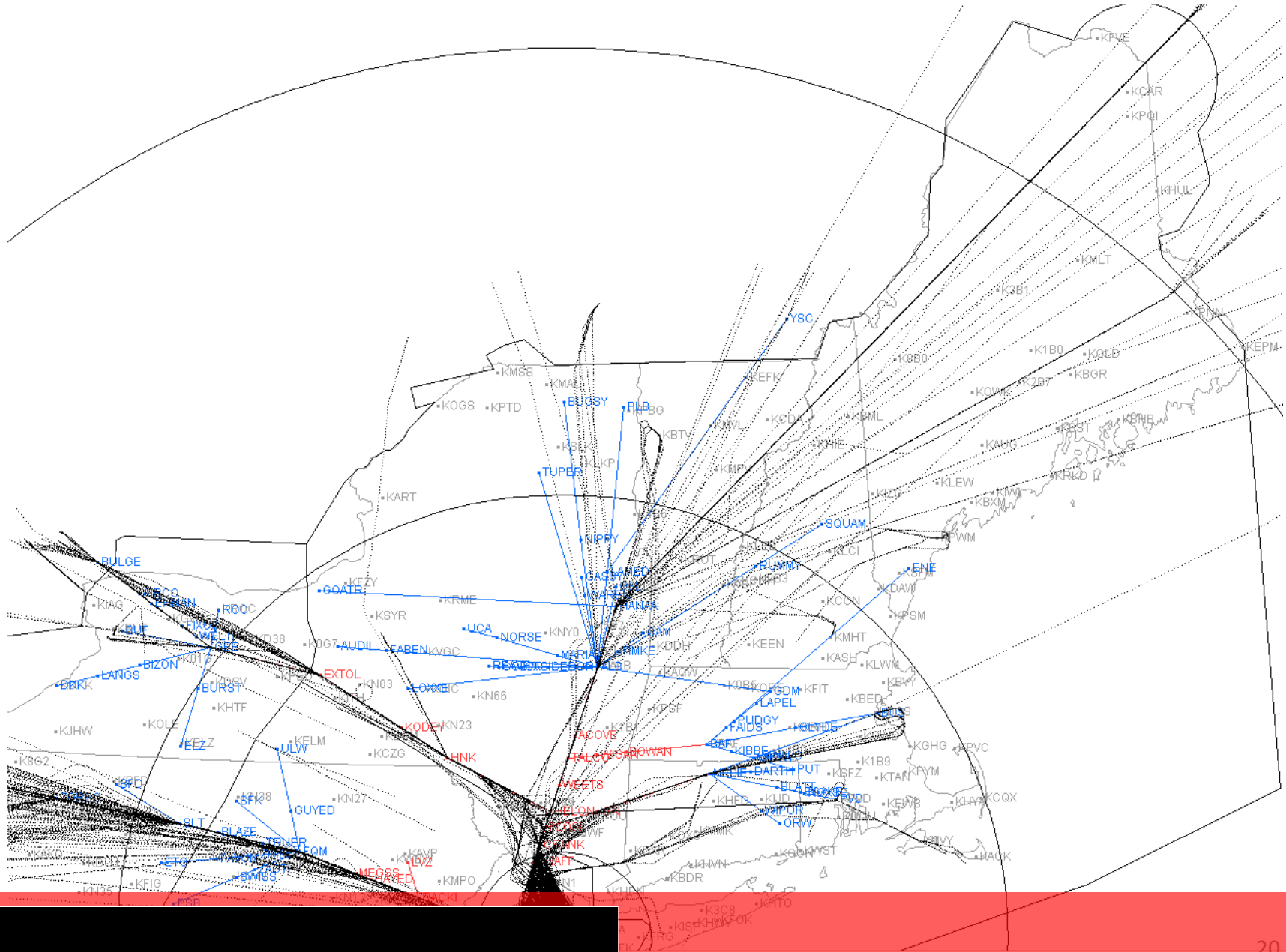
MFX: PENNS

| MRE | Placement | Justification |
|--------|---------------|---|
| MFX | PENNS (PENSA) | Existing (PENSA is the Meter Fix Arc to which scheduling takes place) |
| MFX FH | 140 nm PENNS | ZOB/ZNY boundary, XMP placement |
| XMP | PENX1 | Condition traffic merging over SLT |
| XMP FH | 220 nm PENX1 | NY TBO Concept/400 nm from EWR |

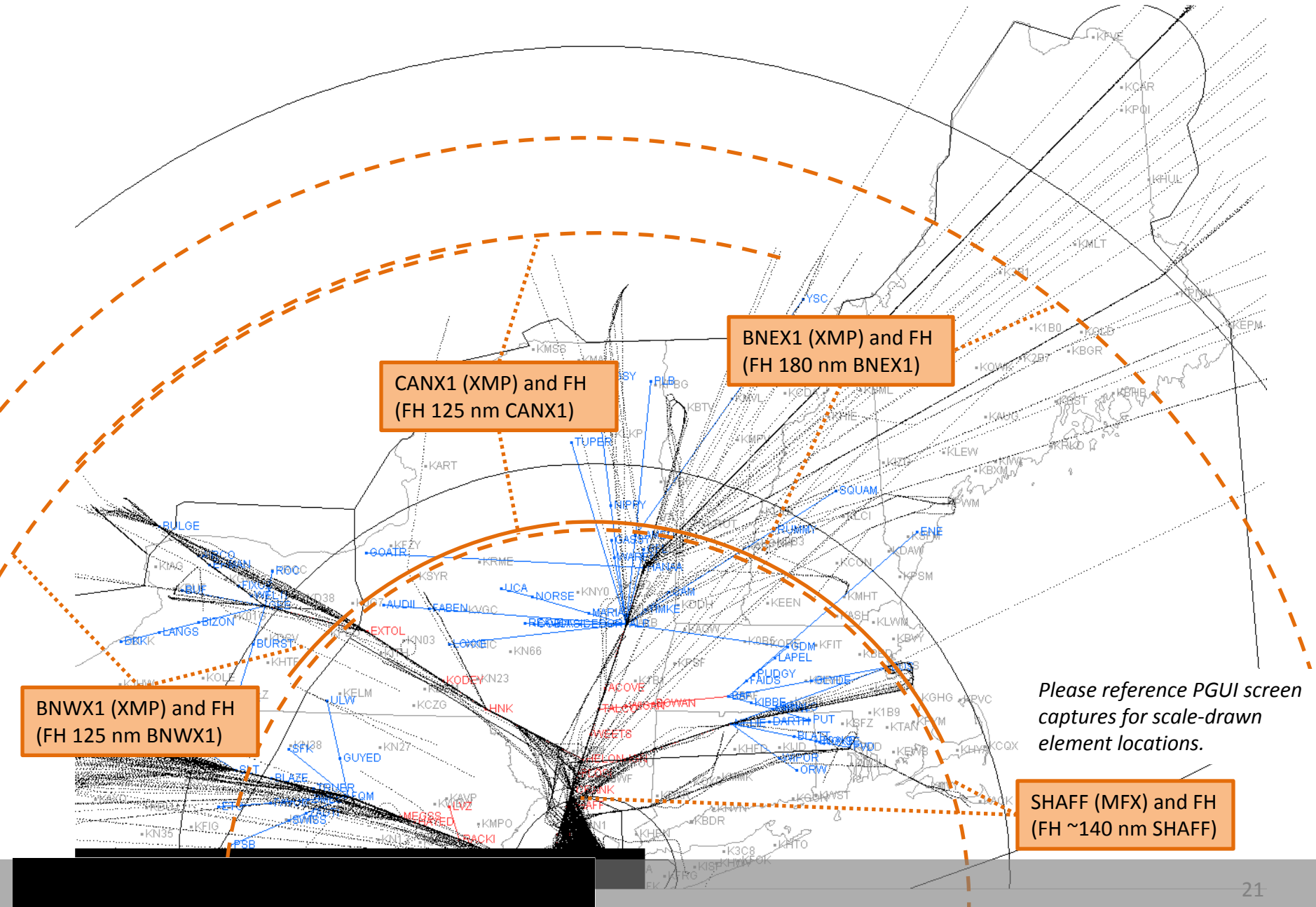
ZBW Detail



ZBW Flows – 07/22/2014



ZBW Flows: MP/FH Locations



Metering Reference Element (MRE) Placement

MFX: SHAFF

| MRE | Placement | Justification |
|--------|--------------|--|
| MFX | SHAFF | Existing |
| MFX FH | 140 nm SHAFF | Consistency with PENNS FH |
| XMP | BNWX1 | Condition traffic merging over EXTOL |
| XMP FH | 125 nm BNWX1 | Maximize coverage of available US airspace to northwest, include as much of available Canadian radar feed as possible (i.e. 125 is notional) |
| XMP | CANX1 | Condition traffic on CAN routes |
| XMP FH | 125 nm CANX1 | Maximize coverage of available US airspace to northwest, include as much of available Canadian radar feed as possible (i.e. 125 is notional) |
| XMP | BNEX1 | Condition traffic merging over ALB, HANAA |
| XMP FH | 180 nm BNEX1 | ZBW does not begin metering prior to this point in today's environment |

Overview of Delay Distribution Parameters

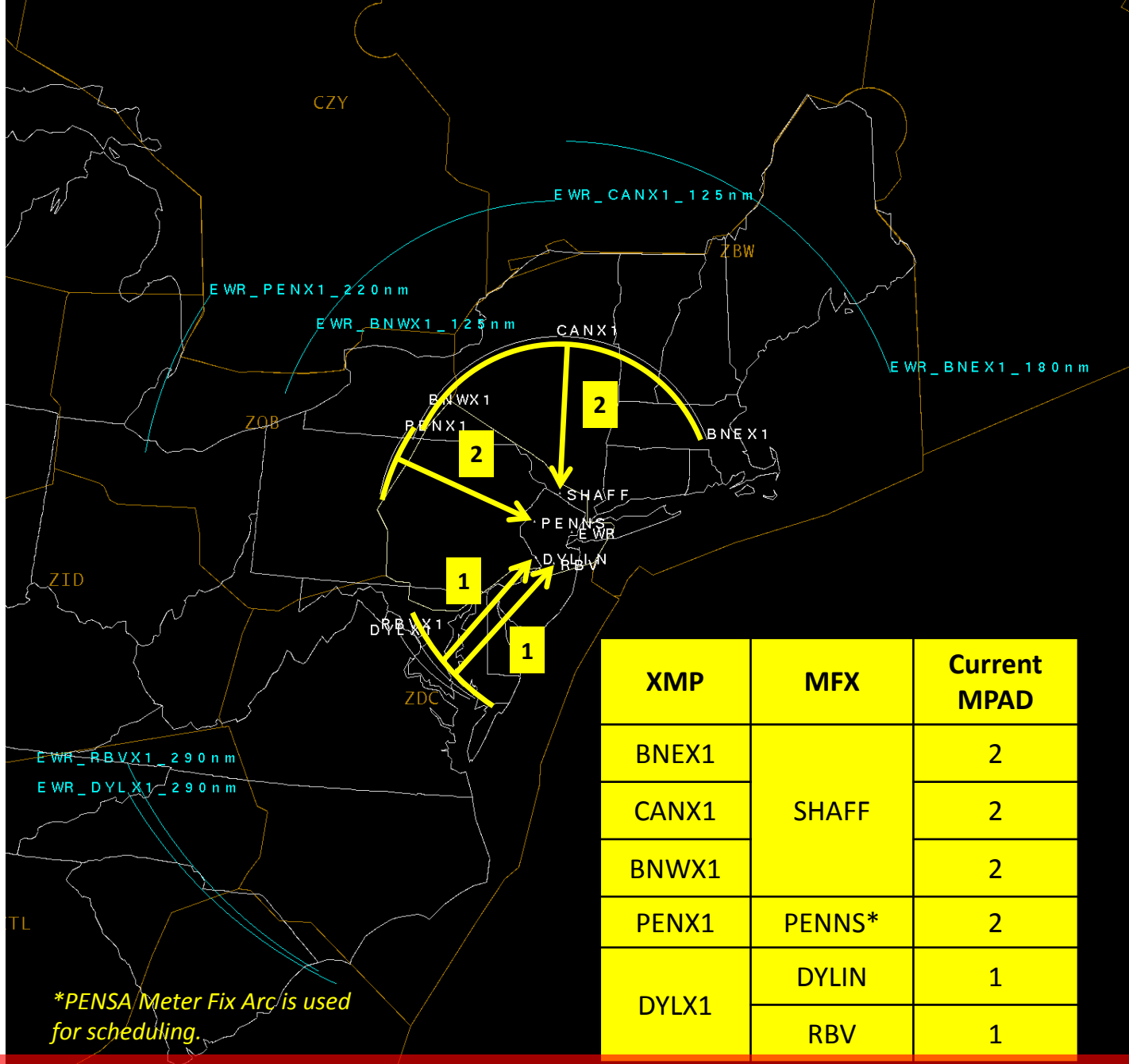
Summary of Delay Distribution Settings

- Maximum delay absorption parameters were defined for the Arrival System in the form of MPAD*, as there were no sector controllers working to meet delay times in the Arrival System and therefore Outer Arcs were not adapted.
 - Typically, delay absorption limits are set in the form of AMDT** values that can be met between pairs of Outer Arcs.
 - The current MPAD settings are shown on the following slide.
- Maximum delay absorption parameters were not defined for the En Route system in order to facilitate display of the full amount of Passback Delay generated by the Arrival System.
- Parameters types (AMDT vs. MPAD) and magnitudes may change for future HITLs.

**MPAD is the delay that can be absorbed in the hold area between the upstream Constraint Satisfaction Point (CSP) (e.g. XMP) and the outer most outer arc adapted for the associated downstream CSP (e.g. MFX).*

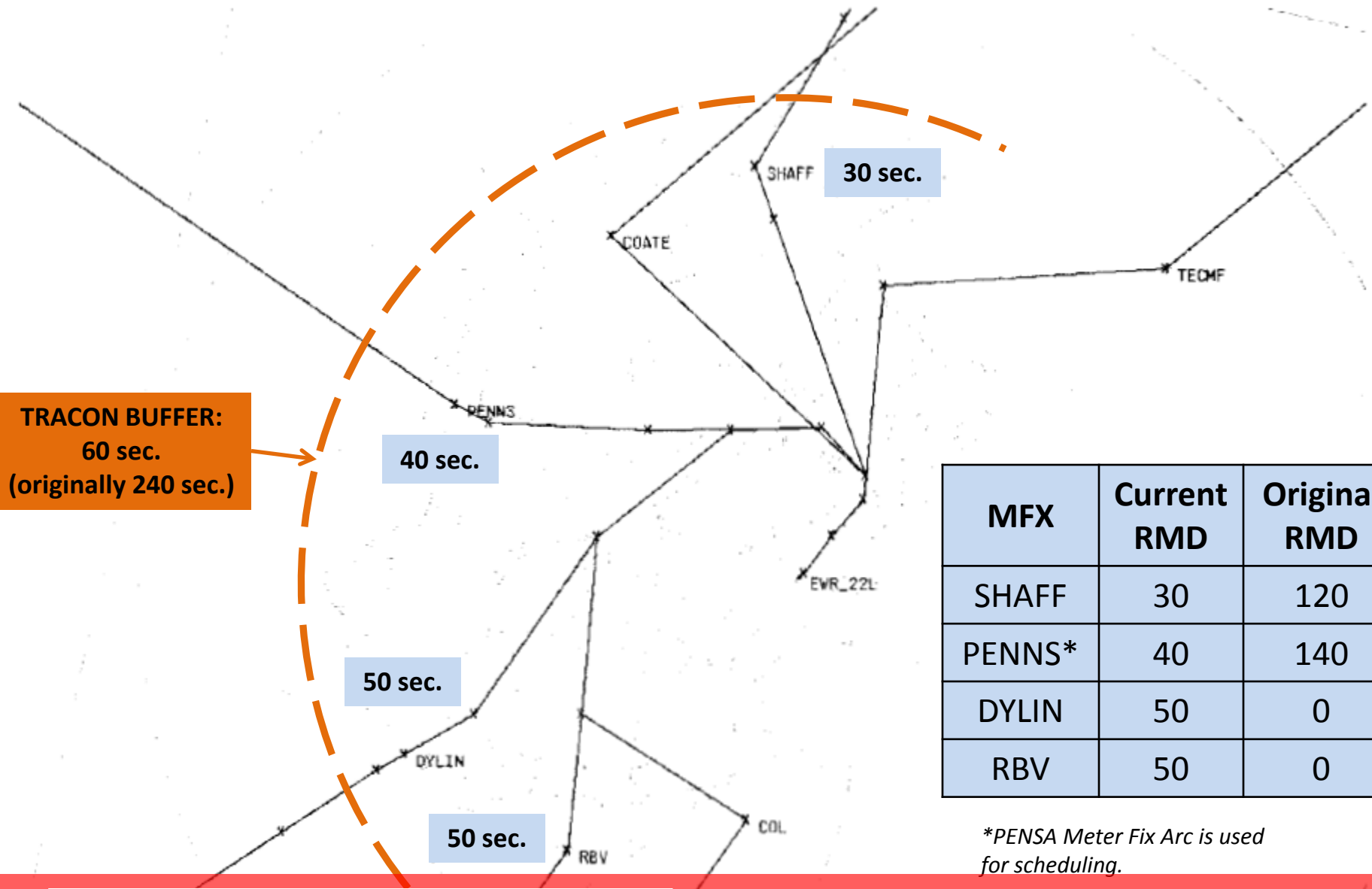
***Amount of Delay Time (AMDT) is the maximum amount of delay in minutes that can be absorbed between two metering reference elements (e.g. two outer arcs).*

Adapted MPAD Parameters



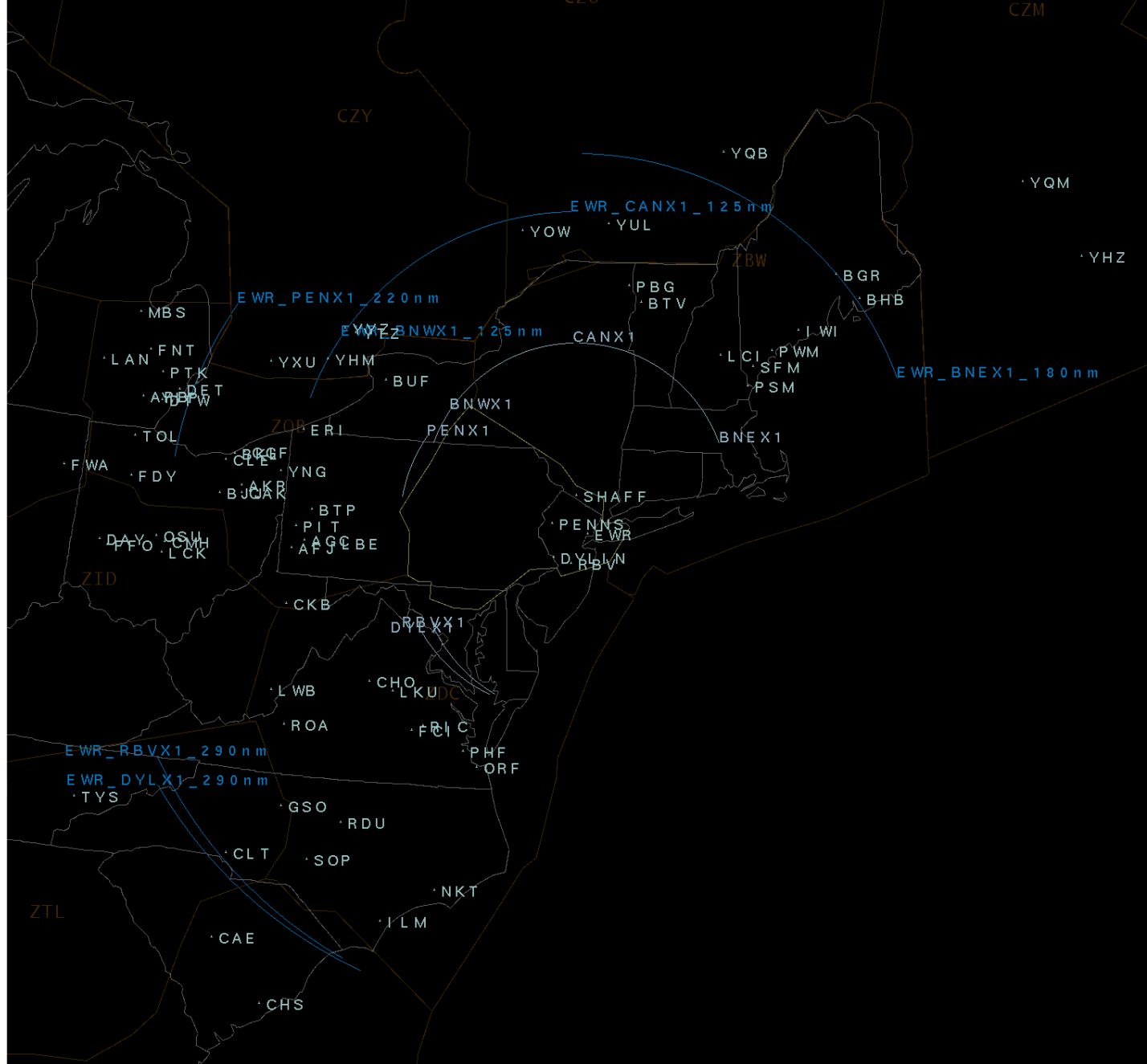
| XMP | MTX | Current MPAD |
|-------|--------|--------------|
| BNEX1 | SHAFF | 2 |
| CANX1 | | 2 |
| BNWX1 | | 2 |
| PENX1 | PENNS* | 2 |
| DYLX1 | DYLN | 1 |
| | RBV | 1 |

TRACON Delay Parameters



Adapted Internal Departure Airports

EDC: All



Airports Scheduled via EDC TGUI: Listed by Center

ZBW

BGR
BHB
BTW
IWI
LCI
PBG
PSM
PWM
SFM
YHZ
YOW
YQB
YQM
YUL

ZDC

CAE
CHO
CHS
CLT
FCI
GSO
ILM
LKU
LWB
NKT
ORF
PHF
RDU
RIC
ROA
SOP
TYS

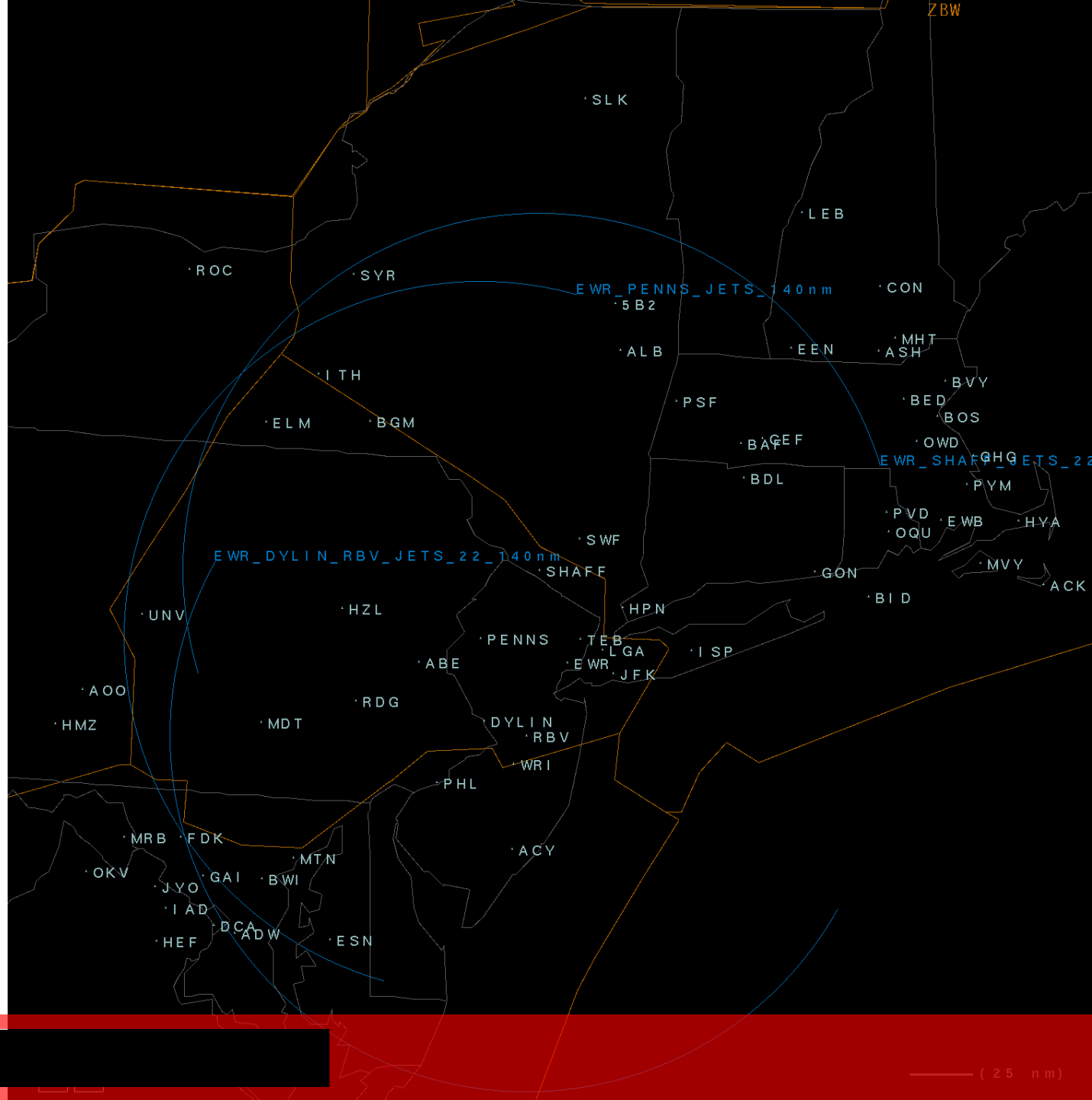
ZOB

AFJ
AGC
AKR
ARB
BJJ
BKL
BTP
BUF
CAK
CGF
CKB
CLE
CMH
DAY
DET
DTW
ERI
FDY
FFO

FNT
FWA
LAN
LBE
LCK
MBS
OSU
PIT
PTK
TOL
YHM
YIP
YNG
YYZ
YXU
Ytz

Note: All airports listed here (except DAY, CHS, TYS, and YQM) were taken from an operational N90 adaptation. DAY, CHS, TYS, and YQM were added to the original list of operationally adapted airports due to their proximity to the XMP FHs and their use in the MACS scenarios.

1



Airports Scheduled via N90 TGUI: Listed by Center

| <u>ZNY</u> | <u>ZBW</u> | | <u>ZDC</u> | <u>ZOB</u> |
|------------|------------|-----|------------|------------|
| ABE | 5B2 | MHT | ACY | AOO |
| BGM | ACK | MVY | ADW | HMZ |
| ELM | ALB | OQU | BWI | ROC |
| EWR | ASH | OWD | DCA | |
| HPN | BAF | PSF | ESN | |
| HZL | BDL | PVD | FDK | |
| ISP | BED | PYM | GAI | |
| ITH | BID | SYR | HEF | |
| JFK | BOS | SLK | IAD | |
| LGA | BVY | | JYO | |
| MDT | CEF | | MRB | |
| PHL | CON | | MTN | |
| RDG | EEN | | OKV | |
| SWF | EWB | | | |
| TEB | GHG | | | |
| UNV | GON | | | |
| WRI | HYA | | | |
| | LEB | | | |